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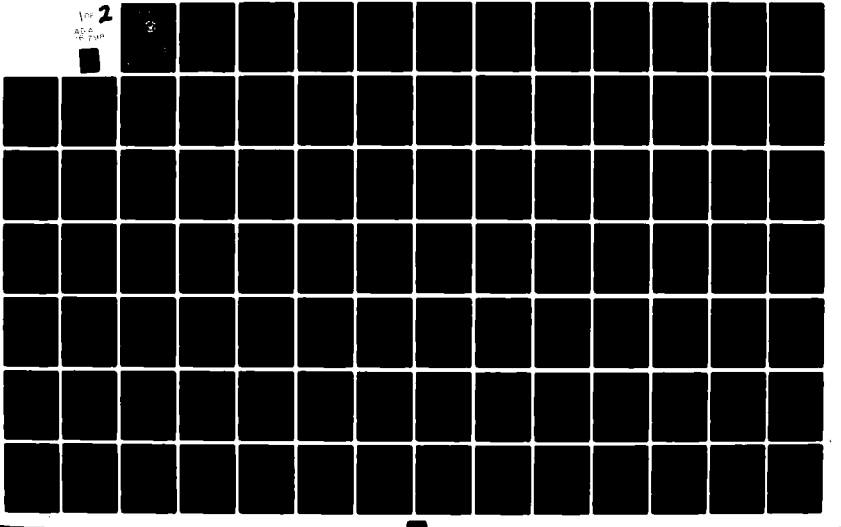

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NAVAL POSTGRADUATE SCHOOL
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THESIS

A VERSION OF THE GRAPHICS-ORIENTED INTERACTIVE FINITE ELEMENT TIME-SHARING SYSTEM (GIFTS) FOR AN IBM WITH CP/CMS

by

Ronnie Hundley

March 1982

Thesis Advisor: G. Cantin

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dimensional truss, plate, shell, and solid finite element models. A brief description of GIFTS, including insights into its logic and structure necessary to the version's development, and an in-depth description of the method used to invoke CMS commands from the executing program for the purpose of data base management are provided. The version, making use of the Tektronix 4000 series graphics terminals, is self-contained and portable, allowing its installation on other IBM computers with the CMS operating system.

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A Version of the Graphics-oriented Interactive Finite Element Time-sharing System (GIFTS) for an IBM with CP/CMS

by

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Lieutenant, United States Navy
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Submitted in partial fulfillment of the requirements for the degrees of

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ABSTRACT

A version of the Graphics-oriented, Interactive, Finite element, Time-sharing System (GIFTS) has been developed for, and installed on, an IBM computer with the Conversational Monitor System (CMS). GIFTS, developed at, and available from the Interactive Graphics Engineering Laboratory of the University of Arizona, is an extensive code for static, transient, modal, and constrained substructural analysis of three dimensional truss, plate, shell, and solid finite element models. A brief description of GIFTS, including insights into its logic and structure necessary to the version's development, and an in-depth description of the method used to invoke CMS commands from the executing program for the purpose of data base management are provided. The version, making use of the Tektronix 4000 series graphics terminals, is self-contained and portable, allowing its installation on other IBM computers with the CMS operating system.

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I. INTRODUCTION

The purpose of this thesis is to describe the development of an IBM (CP/CMS)[1] version of the Graphics-oriented Interactive Finite Element Time-sharing System (GIFTS). GIFTS, developed at, and available from the University of Arizona, is a set of computer programs designed to perform static and dynamic structural finite element analysis, making extensive use of interactive computer graphics which allows the user to ensure correct structural modeling and to view the results of the analysis in a manner most understandable to him.

Versions of GIFTS have been developed for several different computers but not for the IBM, and in particular, for an IBM with CP/CMS. At the Naval Postgraduate School it was desired to provide GIFTS as an instructional tool to the students on a system for which they enjoy ready access and were familiar. This system is the school's main frame, an IBM 3033 with CP/CMS. It was to meet this need that the development was undertaken. A self-contained IBM (CP/CMS) version of GIFTS for an IBM with CP/CMS was developed in such a way as to allow easy implementation on other IBM systems with CP/CMS.

---

[1] International Business Machine with the Command Program and Conversational Monitor System.

It is not the intent of this thesis to provide a detailed description of GIFTS, for this, the reader should consult the GIFTS reference manuals [Refs. 1-4]. It is the intent to provide information on those areas of GIFTS logic and structure that are necessary to the understanding of this version's development and to provide some guidance in the implementation and use of the GIFTS IBM (CP/CMS) version.

II. A BRIEF DESCRIPTION OF GIFTS

GIFTS, developed by Professor Hussein A. Kamel and Mr. Michael W. McCabe of the University of Arizona, is an interactive finite element analysis system designed to provide the user with a unified approach to model generation, model display (tabular or graphical), analysis and result display, with a minimum of input by the user. It may be used as a self-contained system, or as a pre- and post-processor for other systems.[2] It is operational on many systems, including mini-computers with cores having as few as 32,000 words of addressable memory (on mini-computers, the program modules must be overlayed).

GIFTS consists of over 100,000 lines of FORTRAN source code divided among 25 individually executable program modules. The modules, being run independently of each other, communicate by means of an automatically managed, disk resident data base, known as the Unified Data Base (UDB). To perform a complete finite element analysis with GIFTS, the user executes a GIFTS procedure, using a number of modules in a specified order depending on the type of analysis being performed. GIFTS has procedures for static, transient, modal, and constrained substructural analysis of three

[2] Interfaces for pre- and post-processing are available for ANSYS, SAP4, and NASTRAN.

dimensional truss, plate, shell, and solid finite element models. The program modules use interactive computer graphics extensively for viewing the results of model generation and problem solution. GIFTS can also provide the user with the information in tabular form.

A. THE MODULES

The GIFTS program modules vary in size from a few hundred lines to over 12,000 lines of machine independent code. They can be grouped according to their intended use. These groupings are:

1) the model generation and editing modules,
2) the load and boundary condition generation, display and editing modules,
3) the general purpose computational and result display modules,
4) the natural vibration analysis modules,
5) the transient analysis modules, and
6) the constrained substructuring modules.

A brief description of the program modules can be found in Appendix A.

B. THE LIBRARIES

Commonly used subroutines and functions are grouped into a user library called the GIFTS library. For convenience, the GIFTS library is subdivided into five groups called LIBR1, LIBR2, LIBR3, LIBR4, and LIBR5. Of these groups, only LIBR5 contains machine dependent subroutines and

functions. LIBR5 is composed of approximately 30 routines containing machine dependencies that must be modified for each computer system on which GIFTS is implemented. The routines in LIBR5 are grouped according to function. The groups are the Graphics Package, the Character Manipulation Package, and the Data Base Management Package. It was through the modification of, and addition to, these packages that the IBM (CP/CMS) version was developed.

1. The Graphics Package

This is a set of subroutines containing all the necessary software to drive a Tektronix 4000 series graphics terminal. If a different terminal is desired for the graphics output, these subroutines are the ones to be modified.

2. The Character Manipulation Package

These subroutines are used to pack, unpack, compare, and change the format of characters and character strings. They conduct interactive I/O with the user and make Operating System calls for the date, time of day, and CPU time used.

3. The Data Base Management Package

This package of routines performs data base management by invoking primitive file handling functions, such as opening, closing, defining, extending, renaming, printing, and deleting UDB files. It additionally performs all I/O operations with the direct access UDB files.

III. IBM IMPLEMENTATION

Three requirements were established for this IBM (CP/CMS) version development of GIFTS. They were: to maintain the logic of the machine independent routines[3] (that is, not to alter them); to continue the use of the Tektronix 4000 series terminals for graphics; and to provide a self-contained package of routines that would allow installation on other IBM systems with little or no alteration. The only requirement not met was the first, to maintain the logic of the machine independent routines, but it was only necessary to modify subroutine FRESLT[4] in LIBR1. This alteration and the accomplishment of the other requirements are discussed below.

A. THE SYSTEM

The IBM (CP/CMS) version was developed on an IBM 3033 with the Virtual Machine Facility/370 (VM/370) System. It should be noted that VM is not the operating system but rather the virtual machine 'manager'.

The VM/370 system supervises four components: the control program (CP), the conversational monitor system (CMS), the remote spooling communications subsystem (RSCS), and

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[3]The GIFTS' program modules, LIBR1, LIBR2, LIBR3, and LIBR4.

[4]See the Section on the Opening of Files in this Chapter.

the interactive problem control system (IPCS). Only two of these components, CP and CMS, were necessary for the implementation of GIFTS. More detailed information on CP/CMS can be obtained from References [5] through [8].

1. The Control Program (CP)

CP allocates to the virtual machine of each user the resources necessary for proper interface between the virtual machine, with associated virtual input/output (I/O) devices, and the real computer with associated real I/O devices. It additionally allows communication between virtual machines,

2. The Conversational Monitor System (CMS)

CMS is the operating system of the virtual machine and as such has commands for editing, compiling, loading (linking), and executing programs. It also has commands for file manipulation that can be invoked from the CMS environment, an 'EXEC' file[5], or from an executing program. It is through the use of these file manipulation commands, invoked from GIFTS during execution, that the development of this version was made possible. A brief description of the CMS commands used in the IBM (CP/CMS) version can be found in Appendix B.

a. Invoking CMS Commands from an Executing Program

In order to invoke a CMS command from an executing program it was necessary to provide an assembly language

[5]This is the same as a command file in other operating systems.

program that would execute CMS commands passed to it from the executing program. To this end, the assembly program FRTCMX was developed. A listing of FRTCMX can be found in the listing of LIBR5A in Appendix H. FRTCMX executes the CMS commands in the CMS environment, and then returns control to the calling FORTRAN program. As an example, the FORTRAN statement:

```
CALL FRTCMX (IERR,'ERASE   ','PIPJOINT','PTS   ')
```

would delete the file 'PIPJOINT PTS A' from the user's disk space. The argument IERR contains the CMS return code (error code) that could be checked to ensure the command execution was successful. More detailed documentation on the use of FRTCMX can be found in its listing.

b. The CMS File Identifier

CMS also controls the file identifier. A file created under CMS has an identifier composed of three parts: a file name (maximum of 8 characters), a file type (maximum of 8 characters), and a file mode (2 characters). As an example, in the file identifier:

PIPJOINT PTS A1.

PIPJOINT is the file name, PTS is the file type, and A1 (indicating the file is on the user's 'A' disk) is the file mode. CMS does not allow more than one version of a file to exist on a disk space. That is to say, two files on the same

disk space cannot have the same name and file type, which proved to be of some importance in this version's development.[6]

B. THE IBM (CP/CMS) GRAPHICS PACKAGE

As stated earlier, a goal of this verion's development was to continue the use of the Tektronix 4000 series terminals. for graphics. To this end, the GIFTS graphics package supplied by the University of Arizona was used and required only minor modifications. In addition to these modifications, it was necessary to add four assembly routines to provide for ASCII to EBCDIC conversion and non-interfering I/O operations between the graphics package and the terminal. This section is intended to cover the need for the modifications and the added subroutines. A description of all the graphics package's subroutines can be found in Appendix E, and a listing of the assembly routines can be found in Appendix H.

1. ASCII/EBCDIC Translation

The IBM system uses the EBCDIC character set while the Tektronix terminals use ASCII. To allow communication between the computer and an ASCII terminal, an IBM ASCII interface is provided, within the system, that automatically executes the conversion between ASCII and EBCDIC characters. All I/O operations directed to an ASCII terminal must pass through this interface.

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[6]See Section D of this Chapter on Data Base Management.

All output to the terminal from the graphics package is broken up into single characters and placed into an output array named LCHOUT, which is dimensioned 80. These graphics package output characters can be divided into three groups: the graphics characters that are interpreted by the terminal, when in graphics mode, as being coordinates to which the terminal's cursor is to be moved and/or to which a vector is to be drawn; the control characters that place the terminal in alphanumeric mode, graphics mode, erases the screen, rings the bell, etc.; and the text that is to accompany a given plot.

In the GIFTS' graphics package, as with all similar packages, the graphics characters, that is, those characters that provide screen coordinates to the terminal, are computed in ASCII Decimal Equivalent (ADE) integers. These ADE integers, relating directly to ASCII characters, after being calculated, are placed into array LCHOUT for output. If LCHOUT, containing these ADE integers, were output to the terminal, the computer system's ASCII interface would interpret them as being EBCDIC, resulting in improper conversion to ASCII and output to the terminal. Because of this, it is necessary to convert the ADE integers contained in LCHOUT to EBCDIC characters before output to the terminal. This translation, an well as the output to the terminal, is accomplished by the assembly routine WRTADE. WRTADE converts the array of ADE characters to EBCDIC and sends them to the terminal without a carriage return being added to the end of the output

array. For the case where input from the terminal is required by the graphics package, the opposite logic applies. Routine RDADE reads the characters from the terminal, converts them from EBCDIC to ASCII and places them into a desired array for use by the graphics package. More detailed documentation on WRTADE and RDADE can be found in the listing of LIBR5A in Appendix H. Since the graphics characters are calculated in ADE integers and placed into the output array in that form, it is necessary that all other characters placed into the array also be ADE integers. For the control characters, this presents no difficulties since they are already defined in the graphics package in ADE form. The text to accompany the plot, however, is passed to the graphics package as EBCDIC characters in A4 format (up to 4 characters per word). Before the text can be placed into the output array, it must first be broken up into individual characters and converted to ADE integers. This is accomplished by assembly routine TOADE. Additionally, in subroutine CURSOR, following the use of RDADE, it is necessary to translate a character from ADE to EBCDIC for use outside the Graphics Package. The assembly routine TOEBCD is used for this purpose. A listing of both TOADE and TOEBCD can be found in Appendix H.

2. Flushing the Graphics Buffer to the Terminal

When the terminal is in the graphics mode, all characters received are interpreted by the terminal as being either control or graphics characters. If interline characters

are added to the end of the graphics output buffer when 'flushed' to the terminal, they may be interpreted as control characters causing the terminal's mode to be modified, or as graphics characters causing unintended or random vectors to be drawn. As indicated in the previous section, subroutine WRTADE prevents a carriage return from being added to the end of the output buffer, but the IBM system continues to add two characters to the end of the buffer. The first is the control character DC3, and the second the graphics character DEL. Since these characters are added to end of the output buffer, it was necessary to ensure that when the characters are received by the terminal, it would be in alphanumeric mode, thus preventing their interpretation as part of the intended graphics package output. This was accomplished by placing the ADE integer 31 (equivalent to the ASCII control character US), which places the terminal into the alphanumeric mode, into the output array, as the last character.

As a result of placing the terminal into alphanumeric mode at the end of each buffer flush, it was necessary to ensure that the set of graphics characters describing the coordinates for a vector not be split between buffers. If they are split, the desired results may not be obtained. A coordinate description, in ADE form, can consist of up to four characters, so in subroutine PLTCHR, which computes the ADE integers for the desired coordinates, a check is made to ensure that there is room in the output array for at least

four additional characters. If there is not, the array is flushed, which causes the terminal to be left in alphanumeric mode. After this flush, and before PLTCHR continues to calculate the new coordinates, the control character GS (ADE 29), which causes the terminal to switch to graphics mode, is placed into the output array followed by the four control characters that describe the graphic cursor's position prior to the previous flush. It is necessary to provide these coordinates because the first vector drawn after the control character GS is issued to the terminal, is invisible. PLTCHR then continues and calculates the new coordinates and causes them to be placed into the output array.

C. THE IBM (CP/CMS) CHARACTER MANIPULATION PACKAGE

The modifications necessary to the Character Manipulation Package were not extensive in nature and were mainly related to ensuring that the characters used in the many FORTRAN data statements were in EBCDIC form. In addition to these modifications, extensive use was made of five assembly routines provided by the Interactive Graphics Engineering Laboratory of the University of Arizona, for character manipulation. The routines are DECODE, ENCODE, DECOD, BTD, and ENF. A description of all the routines making up the IBM (CP/CMS) Character Manipulation Package can be found in Appendix F and a listing of the assembly routines can be found in Appendix H.

Of importance in this package are the calls to system routines for the date, time of day, and CPU time used. The routine called for the date and time of day is DATIME (called in subroutines DATEP and TIMEP) and for the CPU time used is SETIME (called by subroutine INITIO of the Data Base Management Package) and GETIME (called by subroutine SECOND). If these routines are not available on other systems, appropriate substitutions must be made.

D. THE IBM (CP/CMS) DATA BASE MANAGEMENT PACKAGE

Since the modules communicate with each other through the UDB, it is of the utmost importance that it be correct and managed properly. In addition, it is important that in the management process, that the data base disk space be minimized. This section covers the management of the UDB on the IBM with CP/CMS. A description of all routines used in the IBM (CP/CMS) Data Base Management Package can be found in Appendix G, and a listing of the assembly routines can be found in Appendix H.

1. The IBM (CP/CMS) Data Base

The UDB for the IBM (CP/CMS) version is identical to that of the other versions except for the addition of one file, which will be covered in the SPECIAL SEQUENTIAL DATA BASE FILE section below. The UDB consist of up to 48 random access and 9 sequential files that are managed automatically by GIFTS.

a. The Direct (Random) Access Files

The 48 unformatted direct access UDB files used by the IBM (CP/CMS) version are identical to those used by other versions. It is necessary at this time to introduce some GIFTS terminology in regards to the UDB.

A 'logical record' is the smallest unique collection of data into which the data contained in a file may be divided. As an example, all the data pertaining to one node in the UDB file with the file type PTS make a 'logical record'. The logical record size, in words, is determined by summing the product of the number of 'integers' in the logical record times the number of machine words per integer and the number of 'reals' in the logical record times the number of machine words per real number. Consider again the UDB file with the file type of PTS. It has 10 integers and 17 real numbers per logical record. For single precision, the IBM uses one word for both integer and real numbers, and for double precision, IBM uses one word for integer numbers and two words for real numbers. The word size for a logical record in the PTS file would therefore be 27 for single precision and 44 for double precision.

A 'physical record' is the collection of data that must be read from or written to a file with a single I/O instruction. It may be made up of any integral number of logical records. The number of logical records stored in a physical record of a file is termed the file's 'blocking

factor'. The UDB file type PTS has a blocking factor of 10, and thus a physical record word size of 270 words for single precision and 440 words for double precision. When a physical record is read or written to file type PTS, information on 10 nodes will be involved.

It is the physical record word size that is used in the FORTRAN statement DEFINE FILE to define the random access files. The physical record word size for all the UDB file types can be found in Appendix C. Both single and double precision sizes are included although GIFTS currently is only single precision. It is anticipated that a double precision version will be available in the near future.

The file name assigned to these random access UDB files is the same as the job name provided to GIFTS by the user during module execution. For example, if the user were analyzing a pipe joint, he may provide GIFTS a job name PIPJOINT (the job name, like the file name, is limited to 8 characters), in which case the UDB file type PTS would have the file identifier 'PIPJOINT PTS A'.

b. Sequential Data Base Files

Of the nine sequential files in the UDB, only five will be discussed here, with the remaining four discussed under the heading of SPECIAL SEQUENTIAL DATA BASE FILES below.

These sequential UDB files do not require, as with the direct access files, a specified file size. The file types are CFR, DGT, DYN, HST, and SAV.

The file type CFR is used to store data involved with contours used in module RESULT. File type DGT is used to store digitizer information, while DYN stores information relating to modal analysis, with HST containing information for a histogram plot in transient analysis. File SAV is used to save the stiffness matrix.

These files are automatically created by the GIFTS modules and are given a file name equal to the GIFTS job name.

c. Special Sequential Data Base Files

These files are placed in this cateogry because they do not follow the naming convention of other UDB files and are not necessarily created by the GIFTS modules.

The first of these special UDB files has the file type SRC. An SRC file can be created with any file name, by the user, via the text editor in the CMS environment and will contain a list of GIFTS commands and their associated data. The commands can be executed from an interactive module via the command OLB (On Line Batch). When the OLB command is executed GIFTS prompts the user for the file name of the SRC file. After the file name is entered, the commands contained in the file are read and executed by GIFTS. For more information on the SRC file's use, consult the GIFTS User's Reference Manual [Ref. 1].

The next special file has the identifier GIFTS5 INF and resides on the GIFTS system's disk space. This file

contains a listing of all GIFTS' commands with instructions for their use. The file is accessed from interactive modules via the command HELP. When the command is issued, GIFTS prompts the user for the command for which he desires information. After this is entered, GIFTS opens the file, locates the desired information, and displays it at the terminal for the user.

The last two special files are GIFTS5 EST and GIFTS5 ESX which generally reside on the user's disk space. GIFTS5 EST contains information which is used by solution module OPTIM to make solution time estimates for the solution modules STIFF, DECOM, DEFL, and STRESS. These four modules perform updates to the file during their execution. GIFTS logic is such that during this updating procedure, it performs both read and write operations to GIFTS5 EST. In other computer systems on which GIFTS is operated, this is accomplished by opening one GIFTS5 EST file for input and another for output, on the same disk space. Since the IBM system does not allow two files to exist on the same disk space with the same identifier, this presented a problem. This problem was solved by opening file GIFTS5 EST for input, but having output directed to GIFTS5 ESX. This is accomplished when GIFTS calls for the opening of GIFTS5 EST for output. The subroutine that opens sequential files for output, changes the file type from EST to ESX. When these modules complete their I/O operations on these files, and the files are closed, GIFTS5 EST, now being

superseded by GIFTS5 ESX, is deleted from the user's disk space, so that the user will only have one of these files present on his disk space. When the next GIFTS module is executed, GIFTS5 ESX is renamed GIFTS5 EST, making it ready for input. If the user executes one of the solution modules without GIFTS5 EST or GIFTS5 ESX being present on his disk space, GIFTS will use the GIFTS5 EST file on the GIFTS system's disk space for input and will create GIFTS5 ESX on the user's disk space during output.

2. Defining the Direct Access Files and GIFTS Module IBMUDB

Before unformatted direct access I/O operations can occur, the direct access file must first be defined. This is accomplished with the FORTRAN statement:

```
DEFINE FILE ISL (INR,ISR,U,IV),
```

where: ISL is the logical unit number assigned to the file,

INR is the maximum number of 'physical records' that can be contained in the file,

ISR is the 'physical record' size in words,

U indicates that the records are to be written and read without format control, and

IV is the record number associated variable (not used in GIFTS but must be included in the statement).

In all the versions of GIFTS that have been available, the machine's FORTRAN allowed ISL, INR, and ISR to be integer variables. The logics and structure of the GIFTS data base

management was based on this. This fact allowed the use of one DEFINE FILE statement, located in subroutine DEFIN of LIBR5, in these versions. The logical unit number (ISL), the 'physical record' size in words (ISR), and the number of 'physical records' required (INR), were simply passed as arguments to this subroutine. When it became necessary to increase the size of the file, that is increase the number of records allowed in the file (INR), the file was closed via a call to a system function or through the use of a FORTRAN statement, and then the file would be redefined with the same value for ISR and the increased value for INR. The logical unit number (ISL) for the file could change as the file was opened and closed.

This logic presented a problem for the IBM (CP/CMS) version, since both the IBM FORTRAN G and FORTRAN H-extended, available at the Naval Postgraduate School, do not allow ISL, INR, and ISR to be integer variables. They must be integer constants. Additionally, since there was no way to close a file during execution[7], once the DEFINE FILE statement was made in an executing program, it could not be changed in that program to allow for file growth.

It became clear that a DEFINE FILE statement would be required for each direct access file. For this, logical unit

---

[7]The CMS command FINIS only closes a file in the CMS environment, not in the FORTRAN execution environment (IBCOM).

numbers 50 through 98 were used and the 'physical record' size, in words, was calculated as described in the preceding section on direct access files. This left only the number of 'physical records' (INR) to be entered, and as the only undetermined quantity, with its value dependent on the desire to conserve disk space and to ensure that the user would not be unknowingly constrained by a data base too small for a desired analysis. Both of these seemingly opposite requirements were met through the introduction of the new GIFTS module IBMUDB.

Before continuing with more information on program IBMUDB, it is necessary to explain some facts about direct access file creation on the IBM system and about some additional GIFTS' logic and structure.

Consider the FORTRAN statement:

```
DEFINE FILE 10 (100,27,U,IV).
```

It defines a direct access, unformatted file on logical unit 10. Each 'physical record' will be 27 words long and there may be up to 100 'physical records' written to the file. The statement itself does not cause the creation of this file. It is only after the file is written into that this occurs. If the file did not exist prior to program execution, and only 5 records are written to the file, the system will write those 5 records, plus fill the remaining 95 records with zeros. The result is a great deal of wasted disk space. However, if the file existed on the disk space

prior to the program execution containing this DEFINE FILE statement, there could be a different result. As an example, assume that the file in question was created by a previous program execution containing the statement:

```
DEFINE FILE 10 (1,27,U,IV).
```

This is similar to the previous DEFINE FILE statement except that only one record can be written (or read), as indicated by a value of 1 for INR. When the program containing the DEFINE FILE statement allowing 100 records is executed and the file written into, only those records written will be added to the file. As an example, if during the second program's execution, the same five records are written to the file, only those five records will be written to the disk, not the 100 as before, thus saving disk space. It can be seen that this method, if properly used, could result in the conservation of disk space while allowing for file growth.

It is now necessary to discuss some important facts about GIFTS and its data base management logic. Whenever one of the GIFTS model generation modules[8] is first executed for an analysis, it checks for the presence of the data base files for the given job name, and if they are present, GIFTS calls for the deletion of the old data base and the creation of a new one. If the data base for an analysis was created

[8]Modules BULKM, BULKS, EDITM, and EDITS.

prior to the execution of one of these modules, for the purpose of conserving disk space and allowing for file growth, as described above, its intended purpose would be defeated if it were deleted.

The new GIFTS module IBMUDB was developed to create a 'dummy' data base for GIFTS and is executed prior to performing an analysis on the IBM. In IBMUDB, each direct access data base file is defined with its respective 'physical record' size, in words, and with a maximum of one record. Then, in the first word of that record, the integer -999 is written. Thus, a data base file with -999 in the first word of the first record is considered a 'dummy' data base file, and through the modification of the Data Base Management Package of LIBR5, GIFTS considers a 'dummy' file not to be present. A listing of module IBMUDB can be found in Appendix D.

The DEFINE FILE statements executed in all modules, except IBMUDB, are located in subroutine INITIO of the Data Base Management Package of LIBR5. In these statements, each direct access data base file is defined with its respective logical unit number and 'physical record' size in words, and with a maximum number of records of 1,000,000, which essentially provides the user unlimited growth for the data base. The actual data base size will only be limited by the user's disk space available.

3. Opening of the Data Base Files

On the IBM system, a file is opened automatically when an I/O operation[9] is performed, using the file's logical unit number. If the logical unit number has not been associated with a file identifier by the user, CMS automatically assigns an identifier based on the logical unit number used. As an example, if the sequential I/O statement:

```
WRITE (29,100),
```

were executed without the association, CMS would assign the identifier:

```
FILE FT29F001 A,
```

which tells nothing about the file contents. In keeping with the original structure of GIFTS, the opening of a file was considered to be the association of the proper file identifier with its logical unit number.

In other versions of GIFTS, a maximum of thirteen files (ten direct access and three sequential) were allowed to be open at any given time. Generally, logical unit numbers 1 through 4 and 7 through 12 were used for the direct access files while 13 through 15 were used for the sequential files. The logical unit numbers were assigned by subroutine SLTASN

---

[9]For direct access files the DEFINE FILE statement must precede the I/O operation. Additionally, if the operation is for input, the file must already exist.

of the Data Base Management Package. When necessary, the logical unit number would be released by the closing of the file and then the freeing of the number by subroutine FRESLT in LIBR1. This logic works provided that during the execution of a program, a logical unit number could be used for more than one direct access file identifier, which is not the case for the IBM system with FORTRAN G or FORTRAN H-extended. On the IBM, once a logical unit number is used for a given direct access file, it cannot be associated with any other file. Because of this, in the IBM (CP/CMS) version, each UDB file is assigned its own logical unit number. Subroutine FRESLT, which was in LIBR1 and thus considered a machine independent routine, was moved to LIBR5 and made a 'dummy' routine, that is, it was changed to contain no executable FORTRAN statements. Subroutine SLTASN was also made a 'dummy' routine. These two routines were not deleted from GIFTS because they are called by routines contained in the machine independent portions of GIFTS and it was desired not to alter these. To compensate for the void left by making SLTASN a 'dummy' routine, subroutine MANAGE was added to the Data Base Management Package. This routine relates a data base file type with its respective logical unit number. It will return the logical unit number if provided with the file type or the file type if provided with the logical unit number. MANAGE is called only by routines contained in the Data Base Management Package. The logical unit numbers for each of the data base files can be found in Appendix C.

All the data base files are opened, that is the data base file identifier is associated with its respective logical unit number, by invoking the CMS command FILEDEF during program execution,[10] when called for by GIFTS. For direct access files, this is accomplished in subroutine DEFIN. Here the FILEDEF command is issued and has the form:

```
FILEDEF ISLDEF DISK XJOB EXT8 A (XTENT 1000000 DSORG DA)
```

where: ISLDEF is a double word real variable containing the logical unit number,

DISK indicates the file is to be disk resident,

XJOB is a double word real variable containing the file name,

EXT8 is a double word real variable containing the file type,

A is the file mode,

XTENT 1000000 is the maximum number of records in the extent for the file, and,

DSORG DA indicates that the data set organization is direct access.

For the sequential files, the statement:

```
FILEDEF ISLDEF DISK XJOB EXT8 A
```

is generally used, with ISLDEF, DISK, XJOB, EXT8, and A having the same meaning as for the direct access FILEDEF.

---

[10]This is accomplished via a call to assembly routine FRTCMX discussed in Section A of this Chapter.

Three subroutines, OPENIF, OPENOF, and OPENLP are used to open the sequential files. Subroutine OPENOF opens a file for output and uses a FILEDEF statement identical to the one above. Subroutine OPENIF is used to open a sequential file for input. In this routine, if the file to be opened is either GIFTS5 EST or GIFTS5 INF,[11] a check is made to determine if the file exists on the user's disk, if it does not, the FILEDEF for the file is made with the file mode set to C, where C indicates that the file is to be read from the GIFTS system's disk space to which the user is linked. Subroutine OPENLP opens a sequential file, for output, that may be spooled to the line printer by GIFTS. The FILEDEF used here is:

```
FILEDEF 20 DISK PRTNAM PRNTFILE A,
```

where:

20	is the logical unit number,
DISK	indicates that the file is to be disk resident,
PRTNAM	is a double word real variable containing the file name, provided by the user,
PRNTFILE	is the file type, and,
A	is the file mode.

4. Closing Files

Since the IBM FORTRAN G and FORTRAN H-extended do not provide FORTRAN statements that allow a file to be closed

---

[11] See section entitled Special Sequential Access Files in this Chapter.

during execution, the IBM automatically closes all files opened during execution when the execution is terminated. This, coupled with the fact that GIFTS has not been limited as to the number of files it may have opened during execution (see the previous section), it may at first appear that there is no need to be concerned about closing a file, which is in fact the case in the FORTRAN execution environment, IBCOM. However, in the CMS environment, in order to rename a file, it must be inactive (closed). There is a CMS command, FINIS, that does allow for the closing of a file in the CMS environment. This command is invoked from GIFTS during execution via a call to FRTCMX (see Section A of this Chapter) in subroutine CLOSEF of the Data Base Management Package of LIBR5. This command has been included in CLOSEF for the express purpose of allowing a file to be renamed, which will be discussed later in this Chapter. The FINIS command issued in CLOSEF has the form:

```
FINIS XJOB EXT8 A,
```

where XJOB and EXT8 are double word real variables containing the file name and file type, respectively, and A is the file mode.

There is an additional subroutine called by GIFTS to close a file. It is subroutine CLOSLP, which is intended to close the line printer file and spool it to the line printer as directed by the user. For this version, the system was allowed to close the file at the termination of module

execution. When the subroutine is called, it will, if a printer file has been created, prompt the user if he desires the file to be spooled to the line printer or not. In either case, the file will remain on the user's disk space following execution termination. The CMS command used here is:

```
PRINT PRTNAM PRNTFILE A,
```

where: PRTNAM is a double word real variable containing the file name,

PRNTFILE is the file type, and

A is the file mode.

5. Deleting Files

Based on the discussion in the section entitled DEFINING THE DIRECT ACCESS FILES AND GIFTS MODULE IBMUDB, earlier in this Chapter, it is obvious that deletion of a direct access data base file would defeat the logic behind the use of module IBMUDB. When GIFTS calls subroutine DELETE for the deletion of that file, rather than being deleted, it is made into a 'dummy' file by writing -999 into the first word of the first record of the file. A 'dummy' file will be interpreted by the Data Base Management Package as not being present. Subroutine DELETE does delete sequential files via the CMS command ERASE. This command in DELETE has the form:

```
ERASE XJOB EXT8 A
```

where XJOB, EXT8 and A are the same as those for the FINIS command in the previous section.

6. Renaming Files

During the execution of some of the GIFTS modules, temporary files are created and later renamed. Specifically, the data base file types PTX, LDX, and SLX are created and later renamed PTS, LDS, and SLI, respectively. To understand better the need to do this, and the logic of GIFTS in this matter, consider the file type PTS. This file contains all the information pertaining to the nodes of the model and is first created during model generation. The nodes are entered in the file in numerical order, based on user assigned numbers. Solution module OPTIM is executed to optimize the node numbering in order to decrease the problem 'band width'. In this process, the nodal information is read in from file type PTS, and the nodes are renumbered and output in numerical order, based on the optimization renumbering, to file type PTX. Once this has been accomplished, OPTIM calls for file type PTS, of the current job, to be deleted and for the renaming of file type PTX, of the current job, to be renamed to file type PTS. The renaming is accomplished in subroutine RENAME of the Data Base Management Package. Since direct access files are not actually deleted (see the preceding section on the deleting of files), but rather made into 'dummy' files, both PTS and PTX will actually always be present on the disk. In order to maintain both files on the disk, what is actually desired is an exchange of names between PTS and PTX. This exchange of names is accomplished via the CMS command RENAME with the form:

```
RENAME XJOB PTS A XJOB XXX A
RENAME XJOB PTX A XJOB PTS A
RENAME XJOB XXX A XJOB PTX A
```

Here, the file with the identifier XJOB PTS A is renamed XJOB XXX A, then file XJOB PTX A is renamed XJOB PTS A and finally, file XJOB XXX A is renamed XJOB PTX A. This 'around about' method is necessary due to the fact that no two files can exist on a CMS managed disk with the same identifier.

In subroutine RENAME, the actual RENAME command has the form:

```
RENAME XJOB EXT81 A XJOB XXXXX A
RENAME XJOB EXT82 A XJOB EXT81 A
RENAME XJOB XXXXX A XJOB EXT82 A
```

where: XJOB is a double word real variable containing the file name,

EXT81 and EXT82 are double word real variables, each containing one of the file types to be renamed,

XXXXX is the intermediate file type 'XXX' for the name exchange process, and

A is the file mode.

There is an additional complication to the renaming process resulting from the inability to close a file in the FORTRAN execution environment (IBCOM) of the IBM system. Because of this, once an I/O operation has been performed to a direct access file with its respective logical unit number, that logical unit number cannot be changed. Again consider the file types PTS and PTX. Their logical unit numbers in

this version are 86 and 87 respectively. If, during the execution of OPTIM, after the files have been renamed, an I/O operation is directed at file type PTS (the old PTX file), logical unit number 87 (the logical unit number old file PTX) must be used. Since subroutine MANAGE[12] assigns logical unit numbers based on file types, it was necessary that MANAGE be aware when renaming occurred, so that the renamed files would maintain their original logical unit numbers. This was accomplished by setting a switch, passed to MANAGE by a labeled common block, in RENAME for the files that are renamed.

It was also necessary, in this IBM (CP/CMS) version to rename, if it exists, file GIFTS5 ESX A to GIFTS5 EST A[13] at the start of module execution. This is accomplished by invoking the CMS RENAME command in subroutine INITIO of the Data Base Management Package.

7. Checking for a File's Presence

GIFTS utilizes logical function PRESNT of the Data Base Management Package to check for the presence of a UDB file for use by GIFTS. PRESNT first determines if the file is present on the user's disk space via the CMS command:

STATE XJOB EXT8 A.

---

[12]See the Section on the Opening of Files in this Chapter.

[13]See the section on Special Sequential Data Base Files in this Chapter.

If the file is sequential and is determined to exist on the user's disk space, PRESNT is set equal to TRUE, if not on the disk space, then it would be set to FALSE. For a direct access file, if the file exists on the disk space, the first word of the first record is read and if it does not equal -999, PRESNT is set equal to TRUE, and if it does equal -999, it is a 'dummy' file and PRESNT is set equal to FALSE. If, on the other hand, the file is direct access and is not present on the user's disk space, PRESNT stops module execution and issues the message:

UDB FOR JOB XXXXXXXX NOT CREATED VIA IBMUDB.

where XXXXXXXX will be the job name provided GIFTS by the user.

E. THE ADDED ASSEMBLY ROUTINES (LIBR5A)

For convenience, all the assembly routines for this version of GIFTS have been placed, as entry points, into LIBR5A. A listing of LIBR5A can be found in Appendix H.

F. IBM (CP/CMS) INSTALLATION INSTRUCTION

The installation of GIFTS on the IBM involves the transferring of the source code from tape to the CMS disk space, the compiling of the code, its loading (linking) and execution. This section covers the steps necessary to install GIFTS on the IBM system at the Naval Postgraduate School. Installation on other systems should vary only slightly.

The GIFTS source code is received from the University of Arizona on an unlabeled nine track tape. Accompanying the tape is a tape directory indicating the names and sizes of the files and the order in which they were written onto the tape.

At the Naval Postgraduate School, all but one of the tape drives are attached to MVS (Multiple Virtual System - the batch operating system). Because of this, it has proven expedient to first transfer the files to an MVS disk and then to the CMS disk space. Transfer from the tape to the MVS disk is accomplished via the IBM OS Utility IEBGENER. A listing of the file TAPE2MVS JCL (which resides on the GIFTS disk space), containing the necessary job control statements[14] for the transfer via IEBGENER can be found in Appendix I. These job control statements will cause the first 37 files on the tape to be transferred to disk MVS004 with the respective file identifiers S3161.FILE1 through S3161.FILE37. To transfer the files to the CMS disk space, it is first necessary to link to and access MVS004. This is accomplished by issuing the commands:

```
CP LINK MVS 36B 36B RR
ACCESS 36B E.
```

Once this is done, the files can be transferred to CMS, renamed in accordance with the tape directory, and packed, by

[14]These job control statements are for an 800 bpi ASCII tape.

the use of the CMS commands listed in Appendix I. At the Naval Postgraduate School, these commands are contained in file MVS2CMS EXEC (on the GIFTS disk space) and can be executed by issuing the command MVS2CMS. For future updates, if the number, name, or order of the files to be transferred differ from those now listed in TAPE2MVS JCL and MVS2CMS EXEC, appropriate changes should be made.

All the FORTRAN program modules and libraries, except BULKM and BULKS, can be compiled with the IBM FORTRAN G compiler. It will be necessary, due to variations in the FORTRAN used, to compile BULKM and BULKS with the IBM FORTRAN H-extended compiler.

Following compiling, the program modules and libraries are ready for loading and execution. This, as an example, can be accomplished for program module BULKM, via the CMS commands:

```
LOAD BULKM LIBR1 LIBR2 LIBR3 LIBR4 LIBR5 LIBR5A
START.
```

At the Naval Postgraduate School, this is accomplished by the use of an exec file (see Appendix H).

G. IBM (CP/CMS) USER INSTRUCTIONS

The user's instructions for the IBM (CP/CMS) version vary only slightly from those contained in the GIFTS User's Reference Manual [Ref. 1]. Appendix J contains all necessary additional information to use this version at the Naval Postgraduate School.

IV. SUMMARY AND RECOMMENDATIONS

In summary, the IBM (CP/CMS) version of GIFTS developed is a self-contained, portable system that will allow easy installation on other IBM computers with the CMS operating system.

It is recommended that additional work be done, at the Naval Postgraduate School, on the Graphics Package to enable the use of the Tektronix 618 graphics terminals being installed on the IBM system.

APPENDIX A:

DESCRIPTION OF GIFTS MODULES

IBM DATA BASE INITIALIZATION

IBMUDB — A program to create the dummy[15] data base for the IBM (CP/CMS) version of GIFTS.

MODEL GENERATION AND EDITING

BULKM — An automated three dimensional plate and shell model generator. It is suitable for large continuous structures that can be easily modeled by repetitious generation of points and elements.

BULKS — A three dimensional solid model generator. One may ask for the display of the edges, and may add and display selected point and element slices.

EDITM — Designed to update and correct BULKM models, although it can be used to generate simple models and ones too complex for BULKM.

EDITS — A three dimensional solid mesh editor. It may be used to update or correct BULKS models, or to generate simple models and those too complex for BULKS.

---

[15] See Chapter III, Section D, Subsection 2.

LOAD AND BOUNDARY CONDITION GENERATION, DISPLAY AND EDITING

BULKF — Suppress those freedoms which the generated model cannot support, thereby relieving the user of the necessity of suppressing all superfluous freedoms by hand.

BULKLB — The bulk load and boundary condition generator designed to apply loads to models generated with BULKM. It may be used to apply distributed line and surface loads and masses, prescribed displacements along lines and surfaces, and inertial loads. Temperatures may also be applied to lines and surfaces.

LOADS — The load and boundary condition generator for solid models. Loads may be distributed on lines or surfaces. Loads and boundary conditions may be displayed on point slices.

EDITLB — A display and edit routine intended to provide local modification capability to loads and boundary conditions applied by BULKLB. It may also be used to generate simple loading on models, or loading on models not generated with BULKM. Temperatures may also be applied to elements. After DEFL has been run, the thermal and combined loads may be examined.

GENERAL PURPOSE COMPUTATIONAL AND RESULT DISPLAY MODULES

OPTIM Band width optimization program. OPTIM may be called several times in a row, until the best node numbering scheme has been achieved.

STIFF Computation of element stiffness matrices and their assembly into the master stiffness matrix.

SAVEK This program saves the newly computed stiffness matrix.

PRINT Program used to print out parts of the stiffness matrix and directory for specified GIFTS models.

DECOM Introduces kinematic boundary conditions, and decomposes the stiffness matrix using the Cholesky method.

DEFL Computation of the deflections from the current loading conditions and the decomposed stiffness matrix. If temperatures are present, thermal forces will be calculated and added to the current applied loads before solution.

STRESS Computation of element stresses based on current deflections.

RESULT Result display. The program displays deflections and stresses. It has many options that may be used, at the discretion of the user, to transform the results for optimum comprehension.

RESIDU This program computes the residual forces on a structure solved by the GIFTS solution programs.

THE GIFTS NATURAL VIBRATION PACKAGE

AUTOL Used to generate starting loads for the subspace iteration to compute natural modes of vibration.

SUBS Performs a single subspace iteration to determine the model's natural modes. It must be repeated as many times as necessary to obtain convergence to the desired extent.

THE GIFTS TRANSIENT RESPONSE PACKAGE

TRAN1 Used to specify the time step to be used in the integration process and is to be run on a transient response model immediately after stiffness assembly.

TRAN2 Computes the displacement matrix for time T and is run after TRAN1 and DECOM.

TRANS Maintains and plots histograms of the displacements of up to four different freedoms.

THE GIFTS CONSTRAINED SUBSTRUCTURING PACKAGE

DEFCS Program to define a constrained substructure's (COSUB) boundaries and external nodes.

REDCS This program generates the reduced stiffness and loads matrices necessary for assembly of the 'COSUB' in the main analysis, as well as the transformation matrices necessary for local analysis.

LOCAL This program performs local analysis of selected 'COSUB' models from a major analysis.

THE GIFTS LIBRARIES

LIBR1
LIBR2
LIBR3
LIBR4 Commonly used machine independent subroutines and functions.

LIBR5 Machine dependent FORTRAN subroutines and functions used for graphics, character manipulation and data base management.

LIBRD5A Collection of CP/CMS assembler routines used by LIBR5 of the IBM (CP/CMS) version.

APPENDIX B:

SUMMARY OF CMS COMMANDS USED

COMMANDS USED IN PROGRAM PREPARATION

EDIT	Used to invoke the VM system product editor to create or modify a CMS disk file.
COPYFILE	Used to copy CMS disk files according to given specifications. Used in GIFTS implementation to 'pack' FORTRAN source code to conserve disk space.
FORTG1	Used to compile FORTRAN source code using the G1 compiler.
FORTHX	Used to compile FORTRAN source code using the H-extended compiler.
TXTLIB	Used to generate and modify TEXT libraries.
LOAD	Used to bring TEXT files into storage for execution.
START	Used to begin execution of programs previously loaded into storage.

COMMANDS USED IN GIFTS FOR FILE MANIPULATION

ERASE	Used to delete CMS disk files.
FILEDEF	Used to relate logical unit numbers, devices and files.
FINIS	Used to close files in the CMS environment.

PRINT	Used to spool a specified CMS file to the virtual printer.
RENAME	Used to change the names of CMS files.
STATE	Used to verify the existence of CMS disk files.

APPENDIX C:

THE UNIFIED DATA BASE FOR THE IBM

SEQUENTIAL DATA BASE FILES

FILE TYPE	LOGICAL UNIT NUMBER
CFR	27
DGT	23
DYN	28
HST	25
SAV	24

SPECIAL SEQUENTIAL DATA BASE FILES

FILE TYPE OR IDENTIFIER	LOGICAL UNIT NUMBER
SRC	26
GIFTS5 INF	21
GIFTS5 EST	22
GIFTS5 ESX	29

THE RANDOM ACCESS FILES

FILE TYPE	NUMBER OF INTEGERS	NUMBER OF REALS	BLOCKING FACTOR	IBM SP WORDS	IBM DP WORDS	LOGICAL UNIT NUMBER
CDN	4	180	1	184	364	51
CEE	4	324	1	328	652	56
CLD	4	180	1	184	364	52
DNH	0	6	10	60	120	64
DNI	4	180	1	184	364	53
DNS	0	8	10	80	160	65
DNT	2	72	1	74	146	75
ELD	6	32	5	190	350	77
ELS	0	12	10	120	240	78
ELT	25	10	10	350	450	79
FIL	5	1	1	6	7	98
GRD	43	10	5	265	315	80
INT	5	0	10	50	50	81
KEE	4	324	1	328	652	57
LD2	0	8	10	80	160	66
LDC	0	8	10	80	160	67
LDI	4	180	1	184	364	54
LDS	0	8	10	80	160	68
LDT	2	72	1	74	146	76
LDX	0	8	10	80	160	69
LIN	31	9	10	400	490	82
MAT	5	11	5	80	135	72

FILE TYPE	NUMBER OF INTEGERS	NUMBER OF REALS	BLOCKING FACTOR	IBM SP WORDS	IBM DP WORDS	LOGICAL UNIT NUMBER
MEE	4	324	1	328	652	58
OP0	2	0	40	80	80	73
OP1	4	0	40	160	160	83
OP2	2	0	40	80	80	74
OP3	1	0	40	40	40	84
PAR	25	0	1	25	25	97
PLD	6	8	10	140	220	85
PTS	10	17	10	270	440	86
PTX	10	17	10	270	440	87
RES	0	8	10	80	160	70
SDY	42	0	5	210	210	88
SD2	21	0	5	105	105	89
SLD	129	9	1	138	147	90
SLI	18	0	10	180	180	91
SLX	18	0	10	180	180	92
STC	4	324	1	328	652	59
STF	4	324	1	328	652	60
STR	0	8	10	80	160	71
SUR	4	26	5	150	280	93
TDE	4	324	1	328	652	61
TEM	4	324	1	328	652	62
THS	6	15	5	105	180	94
TIE	4	324	1	328	652	63

FILE TYPE	NUMBER OF INTEGERS	NUMBER OF REALS	BLOCKING FACTOR	IBM SP WORDS	IBM DP WORDS	LOGICAL UNIT NUMBER
TLD	0	84	5	420	840	95
TMP	0	28	5	140	280	96
UGC	4	180	1	184	364	55

APPENDIX D: LISTING OF NEW GIFTS PROGRAM MODULE IBMUDB

```
C ::: THIS PROGRAM CREATES THE DUMMY DATA BASE FOR THE GIFTS IBM(CP/CMS)IBM00010
C     VERSION,                                                          IBM00020
C NPS 4 JAN 82   LT R. HUNDLEY, USN                                     IBM00030
C                                                                       IBM00040
      REAL*8 ISLDEF,EXT(48)                                             IBM00050
      DIMENSION XJOB(2)                                                 IBM00060
      DATA EXT/'CDN     ','CLD     ','DNI     ','LDI     '            IBM00070
     1        ,'UGC     ','CEE     ','KEE     ','MEE     '            IBM00080
     2        ,'STC     ','STF     ','TDE     ','TEM     '            IBM00090
     3        ,'TIE     ','DNH     ','DNS     ','LD2     '            IBM00100
     4        ,'LDC     ','LDS     ','LDX     ','RES     '            IBM00110
     5        ,'STR     ','MAT     ','OP0     ','OP2     '            IBM00120
     6        ,'DNT     ','LDT     ','ELD     ','ELS     '            IBM00130
     7        ,'ELT     ','GRD     ','INT     ','LIN     '            IBM00140
     8        ,'OP1     ','OP3     ','PLD     ','PTS     '            IBM00150
     9        ,'PTX     ','SDY     ','SD2     ','SLD     '            IBM00160
     1        ,'SLI     ','SLX     ','SUR     ','THS     '            IBM00170
     2        ,'TLD     ','TMP     ','PAR     ','FIL     '/           IBM00180
      DATA YES/1HY/                                                     IBM00190
      WRITE (6,100)                                                     IBM00200
      READ (5,101) XJOB                                                 IBM00210
      WRITE (6,103) XJOB                                                IBM00220
      READ (5,105) ANS                                                  IBM00230
      IF (ANS .EQ. YES) GO TO 12                                        IBM00240
      GO TO 11                                                          IBM00250
   12 CALL FRTCMS ('ERASE   ',XJOB,'*       ','A       ')              IBM00260
      DO 10 I=10,57                                                     IBM00270
      ISL=I                                                             IBM00280
      CALL CONVRT (ISL,ISLDEF)                                          IBM00290
      J=I-9                                                             IBM00300
      CALL FRTCMS ('FILEDEF ',ISLDEF,'DISK    ',XJOB,EXT(J),'(        'IBM00310
     1            ,'XTENT   ','1       ','DSORG   ','DA      ')       IBM00320
   10 CONTINUE                                                          IBM00330
C ::: FOR CDN,CLD,DNI,LDI,UGC                                           IBM00340
      DEFINE FILE 10 (1,184,U,IV)                                       IBM00350
      DEFINE FILE 11 (1,184,U,IV)                                       IBM00360
      DEFINE FILE 12 (1,184,U,IV)                                       IBM00370
      DEFINE FILE 13 (1,184,U,IV)                                       IBM00380
      DEFINE FILE 14 (1,184,U,IV)                                       IBM00390
C ::: FOR CEE,KEE,MEE,STC,STF,TDE,TEM,TIE                               IBM00400
      DEFINE FILE 15 (1,328,U,IV)                                       IBM00410
      DEFINE FILE 16 (1,328,U,IV)                                       IBM00420
      DEFINE FILE 17 (1,328,U,IV)                                       IBM00430
      DEFINE FILE 18 (1,328,U,IV)                                       IBM00440
      DEFINE FILE 19 (1,328,U,IV)                                       IBM00450
      DEFINE FILE 20 (1,328,U,IV)                                       IBM00460
      DEFINE FILE 21 (1,328,U,IV)                                       IBM00470
```

```
      DEFINE FILE 22 (1,328,U,IV)                                        IBM00480
C ::: FOR DNH                                                            IBM00490
      DEFINE FILE 23 (1,60,U,IV)                                         IBM00500
C ::: FOR DNS,LD2,LDC,LDS,LDX,RES,STR,MAT,OP0,OP2                        IBM00510
      DEFINE FILE 24 (1,80,U,IV)                                         IBM00520
      DEFINE FILE 25 (1,80,U,IV)                                         IBM00530
      DEFINE FILE 26 (1,80,U,IV)                                         IBM00540
      DEFINE FILE 27 (1,80,U,IV)                                         IBM00550
      DEFINE FILE 28 (1,80,U,IV)                                         IBM00560
      DEFINE FILE 29 (1,80,U,IV)                                         IBM00570
      DEFINE FILE 30 (1,80,U,IV)                                         IBM00580
      DEFINE FILE 31 (1,80,U,IV)                                         IBM00590
      DEFINE FILE 32 (1,80,U,IV)                                         IBM00600
      DEFINE FILE 33 (1,80,U,IV)                                         IBM00610
C ::: FOR DNT,LDT                                                        IBM00620
      DEFINE FILE 34 (1,74,U,IV)                                         IBM00630
      DEFINE FILE 35 (1,74,U,IV)                                         IBM00640
C ::: FOR ELD                                                            IBM00650
      DEFINE FILE 36 (1,190,U,IV)                                        IBM00660
C ::: FOR ELS                                                            IBM00670
      DEFINE FILE 37 (1,120,U,IV)                                        IBM00680
C ::: FOR ELT                                                            IBM00690
      DEFINE FILE 38 (1,350,U,IV)                                        IBM00700
C ::: FOR GRD                                                            IBM00710
      DEFINE FILE 39 (1,265,U,IV)                                        IBM00720
C ::: FOR INT                                                            IBM00730
      DEFINE FILE 40 (1,50,U,IV)                                         IBM00740
C ::: FOR LIN                                                            IBM00750
      DEFINE FILE 41 (1,400,U,IV)                                        IBM00760
C ::: FOR OP1                                                            IBM00770
      DEFINE FILE 42 (1,160,U,IV)                                        IBM00780
C ::: FOR OP3                                                            IBM00790
      DEFINE FILE 43 (1,40,U,IV)                                         IBM00800
C ::: FOR PLD                                                            IBM00810
      DEFINE FILE 44 (1,140,U,IV)                                        IBM00820
C ::: FOR PTS,PTX                                                        IBM00830
      DEFINE FILE 45 (1,270,U,IV)                                        IBM00840
      DEFINE FILE 46 (1,270,U,IV)                                        IBM00850
C ::: FOR SDY                                                            IBM00860
      DEFINE FILE 47 (1,210,U,IV)                                        IBM00870
C ::: FOR SD2                                                            IBM00880
      DEFINE FILE 48 (1,105,U,IV)                                        IBM00890
C ::: FOR SLD                                                            IBM00900
      DEFINE FILE 49 (1,138,U,IV)                                        IBM00910
C ::: FOR SLI,SLX                                                        IBM00920
      DEFINE FILE 50 (1,180,U,IV)                                        IBM00930
      DEFINE FILE 51 (1,180,U,IV)                                        IBM00940
C ::: FOR SUR                                                            IBM00950
```

```
      DEFINE FILE 52 (1,150,U,IV)                                          IBM00960
C ::: FOR THS                                                              IBM00970
      DEFINE FILE 53 (1,105,U,IV)                                          IBM00980
C ::: FOR TLD                                                              IBM00990
      DEFINE FILE 54 (1,420,U,IV)                                          IBM01000
C ::: FOR TMP                                                              IBM01010
      DEFINE FILE 55 (1,140,U,IV)                                          IBM01020
C ::: FOR PAR                                                              IBM01030
      DEFINE FILE 56 (1,25,U,IV)                                           IBM01040
C ::: FOR FIL                                                              IBM01050
      DEFINE FILE 57 (1,6,U,IV)                                            IBM01060
      IDUMY=-999                                                           IBM01070
      DO 20 I=10,57                                                        IBM01080
   20 WRITE (I'1) IDUMY                                                    IBM01090
      WRITE (6,102) XJOB                                                   IBM01100
  100 FORMAT (1X,'ENTER JOB NAME')                                         IBM01110
  101 FORMAT (2A4)                                                         IBM01120
  102 FORMAT (1X,'GIFTS UNIFIED DATA BASE FOR JOB',1X,2A4,1X,'CREATED.')   IBM01130
  103 FORMAT (1X,'THIS WILL DESTROY ALL FILES NAMED',1X,2A4,'.'            IBM01140
     1       /1X,'DO YOU WISH TO CONTINUE (Y/N)?')                         IBM01150
      STOP                                                                 IBM01160
   11 WRITE (6,104) XJCB                                                   IBM01170
  104 FORMAT (1X,'GIFTS UDB FOR JOB',1X,2A4,'NOT CREATED.')                IBM01180
  105 FORMAT (A1)                                                          IBM01190
      STOP                                                                 IBM01200
      END                                                                  IBM01210
```

APPENDIX E:

THE IBM (CP/CMS) GRAPHICS PACKAGE SUBROUTINES
(* indicates a modified or added subroutine)

ANMODE — Places the Tektronix 4000 series graphics terminal into the alphanumeric mode.

CURSOR * — Turns on the graphics cursor, and reads back the x and y coordinates of the cursor position when a character is struck on the key board. It also returns the value of the character struck. This subroutine calls assembly routine RDADE for the input operation and TOEBCD for conversion of the character to EBCDIC.

DINIT — This subroutine clears the terminal screen and positions the graphics cursor at (0,0) in the viewing area.

DRAW — Draws a visible line from the current beam position to the absolute coordinates provided.

FLUSH * — This subroutine dumps the graphics output array to the terminal and insures that the last character in the array is US, which places the terminal into alphanumeric mode preventing the interpretation of interline characters, sent by the IBM system, as graphics characters. Assembly routine WRTADE is used to dump the buffer.

INTERP	This function linearly interpolates point coordinates for graphics output.
LINA	This subroutine will draw an invisible or visible line, as directed, from the current graphics cursor position to the absolute coordinates provided.
LINE	This subroutine will draw an invisible or visible line, as directed, from the current graphics cursor position to the absolute coordinates provided.
MOVE	Subroutine that invisibly moves the terminal's graphics cursor to the absolute screen coordinates provided.
OFFSET	This subroutine switches the Graphics Package between the 800 x 800 main viewing area and the 800 x 223 offset viewing area.
PLTCHR *	This subroutine computes, and outputs, the graphic control characters necessary to draw a line from the current beam position to the absolute screen coordinates provided. It will send the minimum number of characters needed, from one to four. If the output array does not have room for at least four characters, it is flushed to the terminal. Following the flush, the terminal is placed back into graphics mode and the cursor moved back to its position prior to the flush.

PUTCHR This subroutine adds characters to the output array. If number of characters in the array reaches NCHMAX, the array is flushed.

SETPT This subroutine invisibly positions the graphics beam to the absolute screen coordinates provided.

TABLET * This subroutine reads one point from the digitizing tablet. It is currently inactive in this version.

TBELL Rings the bell on the terminal.

TERASE Erases the terminal screen.

TEXT * This subroutine outputs characters from a provided array to the screen, starting at the current alphanumeric cursor position. The text will be clipped at the edges of the screen. Assembly routine TOADE is used to unpack the text and convert it to ADE.

THOME This subroutine moves the graphics cursor to the home position, and switches the terminal to alphanumeric mode.

TINITT * This subroutine initializes the Graphics Package, clears the terminal screen, and positions the graphics cursor at (0,0) in the main viewing area. NCHMAX is set equal to 79 here.

TWAIT This subroutine causes the program to wait for a given number of seconds. This is accomplished in this version by the output of a string of non-interfering characters to the terminal.

WRTADE * This assembly routine converts an array of ADE characters to EBCDIC and sends them to the terminal with the interline characters suppressed. WRTADE is an entry point in LIBR5A.

RDADE * This assembly routine reads characters from the terminal, converts them from EBCDIC to ADE, and places them into a specified array. RDADE is an entry point in LIBR5A.

TOADE * This assembly routine converts a string of consecutive EBCDIC character into ADE characters and puts them into consecutive elements (right justified) of a full word array. TOADE is an entry point in LIBR5A.

TOEBCD * This assembly routine converts a string of consecutive ADE character into EBCDIC characters and puts them into consecutive elements (right justified) of a full word array. TOEBCD is an entry point in LIBR5A.

APPENDIX F:

THE IBM (CP/CMS) CHARACTER MANIPULATION PACKAGE SUBROUTINES
(* indicates modified or added subroutines)

DATEP * This subroutine calls IBM Operating System function DATIME for the date and converts it into 3A4 format.

ENI * This subroutine encodes an integer into a floating point variable, left-justified and blank filled, and returns the floating point variable and the number of characters it contains.

FREAD * This subroutine controls interactive I/O operations with the user via the terminal.

FREAD2 * This subroutine controls interactive I/O operations with the user via the terminal or digitizing tablet.

INCCHR * This subroutine takes a single character, left-justified and blank filled, and increments it by one.

INCHAR * This logical function reads a line from the user's terminal or steering file as directed by subroutine FREAD.

INCHR2 * This logical function reads a line from the user's terminal, steering file, or digitizing tablet as directed by subroutine FREAD2.

INCNM * This subroutine takes an alphanumeric eight character name and increments the numeric characters in the name by a specified amount. Calls assembly routine BTD.

INIHVL * This subroutine initializes the hardware value list for the computer hardware being used.

INMENU * This subroutine reads an input line from the tablet menu.

NUMCHR * This subroutine counts the number of non-blank characters in a single alphanumeric name.

PAKAL * This subroutine packs alphanumerical information into a single word in A4 format. Makes a call to assembly routine ENCODE for this.

PERCNT * This subroutine encodes an integer followed by a '%' sign into a floating point variable and then passes it to subroutine TEXT of the Graphics Package for inclusion in a plot. A call is made to assembly routines DECODE and ENCODE to aid in the process.

SECOND * This subroutine returns the elapsed CPU time in seconds. CPU time is obtained via a call to the system routine GETIME.

TIMEP * This subroutine gets the current time of day from the operating system, via a call to DATIME, and reformats it to 3A4 format.

UPKAL * This subroutine unpacks text in A4 format into a four word array with one character per word, right justified and zero (null) filled. UPKAL calls assembly routine DECOD for this.

DECODE * This added assembly routine unpacks a string of characters (4 per word) into a four word array with each word containing one left justified character. DECODE is an entry point in LIBR5A.

ENCODE * This added assembly routine packs a string of characters contained in single character words, into a single word. ENCODE is an entry point in LIBR5A.

DECOD * This added assembly routine unpacks the characters (maximum of 4) contained in a single word into four single character words, with the characters right justified and the word padded with zeroes (nulls). DECOD is an entry point in LIBR5A.

BTD * This added assembly routine transforms an integer into a string of alphanumeric characters. The string is right justified with the rest of the string filled with a character provided by the user. It additionally returns the number of characters in the string. BTD is an entry point in LIBR5A.

ENF * This assembly routine replaces a FORTRAN routine. It translates an array in 3A4 format into the floating point format 1PE10.3. ENF is an entry point in LIBR5A.

APPENDIX G:

THE IBM (CP/CMS DATA BASE MANAGEMENT PACKAGE SUBROUTINES

(* indicates a modified or added subroutine)

CLOSEF * This subroutine closes an active file in the CMS environment via the CMS command FINIS. In addition, if the file being closed is GIFTS5 ESX, this subroutine calls for the deletion of GIFTS5 EST.

CLOSLP * This subroutine spools to the line printer, if directed by the user, the line printer file via the CMS command PRINT.

DEFIN * This subroutine associates direct access file identifiers with their respective logical unit numbers via the CMS command FILEDEF. It will also zero, or expand, a direct access UDB file as directed.

DELETE * This subroutine makes direct access UDB files into 'dummy' files and deletes sequential UDB files via the CMS command ERASE.

INITIO * This routine initializes the logical unit numbers for the direct access UDB files, defines all direct access UDB files, turns on the IBM CPU timing via a call to routine SETIME, and the current GIFTS version number. Additionally, if file GIFTS5 ESX exists, it is renamed GIFTS5 EST.

INRA This subroutine performs all input from the direct access UDB files.

OPENIF * This subroutine opens a specified sequential file for input by associating the file identifier with its respective logical unit number via the CMS command FILEDEF. If the file is GIFTS5 INF or GIFTS5 EST and does not exist on the user's disk space, it is specified as being on the GIFTS system's disk space.

OPENLP * This subroutine sets the line printer file logical unit number and associates the file identifier, provided by the user, with this logical unit number via the CMS command FILEDEF.

OPENOF * This subroutine opens a specified sequential file for output by associating the file identifier with its respective logical unit number via the CMS command FILEDEF. If the file to be opened is GIFTS5 EST, file GIFTS5 ESX is opened in its place.

OUTRA This subroutine performs all output to the direct access UDB files.

PRESNT * This logical function checks for the presence of a UDB file. If the file is sequential and not present, PRESNT is set equal to false, and if it is present, PRESNT is set equal to true. If the file is direct access, present on the user's disk

space, and a 'dummy' file, PRESNT is set equal to false. And if on the user's disk space and not a 'dummy' file, PRESNT is set equal to true. If the file is direct access and is not present on the user's disk space, program module execution is terminated.

RENAME * This subroutine uses the CMS command RENAME to effect the exchange of names between two UDB files. When renaming occurs, it also sets a switch to indicate to subroutine MANAGE that the renaming has taken place.

MANAGE * This subroutine will assign a logical unit number, if provided with the UDB file type, or the UDB file type, if provided with the logical unit number. If a file has been renamed, MANAGE will relate the old logical unit number with the new file type.

SLTASN * For this version, SLTASN is a dummy routine.

FRESLT * This subroutine was moved from LIBR1 for this version and is a dummy routine.

FRTCMX * This assembly routine allows CMS commands to be invoked from the executing program module. FRTCMX is an entry point in LIBR5A.

CONVRT * An assembly routine used to convert a four byte integer logical unit number into an eight byte real number. It is used in passing information on the logical unit number to FRTCMX for the execution of CMS commands requiring the number. CONVRT is an entry point in LIBR5A.

APPENDIX H: LISTING OF THE IBM (CP/CMS) ASSEMBLY ROUTINES

```
*********************************************************************** LIB00010
*                                                                     * LIB00020
*                                                                     * LIB00030
*       LIBR5  IS A COLLECTION OF ROUTINES FOR USE WITH THE GIFTS     * LIB00040
*                          LIBRARY  LIBR5                             * LIB00050
*                                                                     * LIB00060
*       ENTRY POINTS ARE:   WRTADE                                    * LIB00070
*                           RDADE                                     * LIB00080
*                           TOADE                                     * LIB00090
*                           TCEBCD                                    * LIB00100
*                           DECODE                                    * LIB00110
*                           ENCODE                                    * LIB00120
*                           DECOD                                     * LIB00130
*                           BTD                                       * LIB00140
*                           ENF                                       * LIB00150
*                           FRTCMX                                    * LIB00160
*                           CONVRT                                    * LIB00170
*                                                                     * LIB00180
*********************************************************************** LIB00190
         MACRO                                                        LIB00200
&NAME    BEGIN                                                        LIB00210
         DROP   12                                                    LIB00220
         ENTRY  &NAME                                                 LIB00230
         USING  *,15                                                  LIB00240
&NAME    SAVE   (14,12),T,*                                           LIB00250
         L      12,ALIBR5A                                            LIB00260
         DROP   15                                                    LIB00270
         USING  LIBR5A,12                                             LIB00280
         LA     15,SAVEAREA                                           LIB00290
         ST     13,4(,15)                                             LIB00300
         ST     15,8(,13)                                             LIB00310
         MEND                                                         LIB00320
         EJECT                                                        LIB00330
LIBR5A   START  0                                                     LIB00340
         USING  *,12                                                  LIB00350
*                                                                     LIB00360
```

```
*         START ROUTINES FOR GRAPHICS PACKAGE OF LIBR5.                    LIB00370
*                                                                          LIB00380
************************************************************************** LIB00390
*                                                                        * LIB00400
*  WRTADE CONVERTS AN ARRAY OF ADE CHARACTERS TO EBCDIC AND SENDS THE    * LIB00410
*  CHARACTERS TO THE TERMINAL WITH INTERLINE CHARACTERS SUPPRESSED.      * LIB00420
*                                                                        * LIB00430
*     FORTRAN CALLING SEQUENCE:  CALL WRTADE(NCHAR,IARAY)                * LIB00440
*                                                                        * LIB00450
*        WHERE NCHAR = LENGTH OF IARAY.                                  * LIB00460
*              IARAY = INTEGER ARRAY, EACH ELEMENT CONTAINS              * LIB00470
*                      AN ADE CHARACTER RIGHT JUSTIFIED.                 * LIB00480
*                                                                        * LIB00490
************************************************************************** LIB00500
          ENTRY WRTADE                                                    LIB00510
WRTADE    B     12(15)                                                    LIB00520
          DC    AL1(6)                                                    LIB00530
          DC    CL6'WRTADE'                                               LIB00540
          SAVE  (14,12)                                                   LIB00550
          LR    R12,R15                                                   LIB00560
          USING WRTADE,R12                                                LIB00570
          ST    R13,SAVAR+4                                               LIB00580
          LA    R13,SAVAR                                                 LIB00590
*                                                                         LIB00600
          L     R2,0(R1)          R2=ADDR OF PARM1                        LIB00610
          L     R4,0(R2)          R4=PARM1                                LIB00620
          LTR   R4,R4             R4 > 0?                                 LIB00630
          BP    POS               BR IF POSITIVE                          LIB00640
          B     RETOUT                                                    LIB00650
POS       L     R5,4(R1)          R5=ADDR OF PARM2                        LIB00660
          LA    R6,BUFF          R6=ADDR OF OUTPUT BUFFER                 LIB00670
OUTLOOP   MVC   0(1,R6),3(R5)     MOVE BYTE TO OUTPUT BUFFER              LIB00680
          LA    R5,4(R5)          NEXT WORD ON INPUT ARRAY                LIB00690
          LA    R6,1(R6)          NEXT BYTE IN OUTPUT STRING              LIB00700
          BCT   R4,OUTLOOP                                                LIB00710
          L     R4,0(R2)          R4=PARM1                                LIB00720
          LA    R6,BUFF          R6=ADDR OF BUFF                          LIB00730
          STC   R4,TRANS+1        NUMBER OF CHARS TO TRANSLATE            LIB00740
TRANS     TR    0(1,R6),TABLEOUT   TRANSLATE                              LIB00750
          WRTERM BUFF,(R4),EDIT=LONG,COLOR=B                              LIB00760
          WAITT                                                           LIB00770
RETOUT    L     R13,SAVAR+4                                               LIB00780
          LM    R14,R12,12(R13)                                           LIB00790
          LA    R15,0                                                     LIB00800
          BR    R14                                                       LIB00810
          EJECT                                                           LIB00820
*         END WRTADE                                                      LIB00830
```

```
*********************************************************************** LIB00850
*                                                                     * LIB00860
*  RDADE ACCEPTS CHARACTERS FROM THE TERMINAL, TRANSLATES THEM FROM   * LIB00870
*  EBCDIC TO ADE, PUTTING ONE CHARACTER (RIGHT JUSTIFIED) IN EACH     * LIB00880
*  ELEMENT OF IARAY.  NCHAR IS THEN ASSIGNED THE NUMBER OF            * LIB00890
*  CHARACTERS READ.                                                   * LIB00900
*                                                                     * LIB00910
*     FORTRAN CALLING SEQUENCE:  CALL RDADE(NCHAR,IARAY)              * LIB00920
*                                                                     * LIB00930
*        WHERE NCHAR = NUMBER OF CHARACTERS READ.                     * LIB00940
*              IARAY = INTEGER ARRAY, EACH ELEMENT WILL CONTAIN       * LIB00950
*                      AN ADE CHARACTER RIGHT JUSTIFIED.              * LIB00960
*********************************************************************** LIB00970
         ENTRY RDADE                                                    LIB00980
RDADE    B     10(15)                                                   LIB00990
         DC    AL1(5)                                                   LIB01000
         DC    CL5'RDADE'                                               LIB01010
         SAVE  (14,12)                                                  LIB01020
         LR    R12,R15                                                  LIB01030
         USING RDADE,R12                                                LIB01040
         ST    R13,SAVAR+4                                              LIB01050
         LA    R13,SAVAR                                                LIB01060
         LR    R2,R1           R2=ADDR OF PARM LIST                     LIB01070
TMACIN   RDTERM BUFF,EDIT=NO                                            LIB01080
         ST    R0,LN                                                    LIB01090
         L     R4,0(R2)          R4=ADDRESS OF NCHAR                    LIB01100
         L     R6,4(R2)          R6=ADDRESS OF IARAY                    LIB01110
         SR    R8,R8                                                    LIB01120
         IC    R8,LN+3           R8=LENGTH OF INPUT LINE                LIB01130
         ST    R8,0(R4)          PUT LENGTH IN NCHAR                    LIB01140
         LTR   R8,R8             LN NOT POS?                            LIB01150
         BNP   RETIN                                                    LIB01160
         STC   R8,TRANIN+1       NUMBER OF CHARS TO BE TRANSLATED       LIB01170
         LA    R7,BUFF         R7=ADDR OF BUFF                          LIB01180
         SR    R9,R9             R9=00000000                            LIB01190
TRANIN   TR    0(1,R7),TABLEIN                                          LIB01200
INLOOP   ST    R9,0(R6)          ZERO OUTPUT WORD                       LIB01210
MOVIN    MVC   3(1,R6),0(R7)     MOVE FROM BUFF TO IARAY                LIB01220
         LA    R6,4(R6)          NEXT WORD IN IARAY                     LIB01230
         LA    R7,1(R7)          NEXT BYTE IN BUFF                      LIB01240
         BCT   R8,INLOOP       LOOP FOR NCHAR BYTES                     LIB01250
RETIN    L     R13,SAVAR+4                                              LIB01270
         LM    R14,R12,12(R13)                                          LIB01280
         LA    R15,0                                                    LIB01290
         BR    R14                                                      LIB01300
         EJECT                                                          LIB01310
*        END RDADE                                                      LIB01320
```

```
*                                                                       LIB01330
*************************************************************************LIB01340
* SUBROUTINE TOADE  CONVERTS A STRING OF CONSECUTIVE EBCDIC CHARACTERS* LIB01350
* INTO ASCII DECIMAL ECUIVALENT CHARACTERS AND PUTS THEM INTO          * LIB01360
* CONSECUTIVE ELEMENTS (RIGHT JUSTIFIED) OF A FULL WORD INTEGER ARRAY.* LIB01370
*                                                                      * LIB01380
*    FORTRAN CALLING SEQUENCE:  CALL TOADE(NCHAR,KAM,KADE)             * LIB01390
*                                                                      * LIB01400
*         WHERE: NCHAR= NUMBER OF BYTES IN INPUT STRING.               * LIB01410
*                KAM=   INPUT STRING OF EBCDIC CHARACTERS.             * LIB01420
*                KADE=  FULL WORD OUTPUT ARRAY OF LENGTH NCHAR.        * LIB01430
*************************************************************************LIB01440
         ENTRY TOADE                                                    LIB01450
TOADE    B     12(0,15)                                                 LIB01460
         DC    AL1(6)                                                   LIB01470
         DC    CL6'TOADE'                                               LIB01480
         USING TOADE,R12                                                LIB01490
         SAVE  (14,12)                                                  LIB01500
         LR    R12,R15                                                  LIB01510
         ST    R13,SAVAR+4                                              LIB01520
         LA    R13,SAVAR                                                LIB01530
*                                                                       LIB01540
         L     R2,0(R1)          R2=ADDR OF PARM1                       LIB01550
         L     R4,0(R2)          R4=PARM1                               LIB01560
         L     R5,4(R1)          R5=ADDR OF PARM2                       LIB01570
         L     R6,8(R1)          R6=ADDR OF PARM3                       LIB01580
         L     R8,ZEROES         R8=00000000                            LIB01590
LAM2AS   ST    R8,0(R6)          ZERO OUTPUT WORD                       LIB01600
         MVC   3(1,R6),0(R5)     MOVE BYTE FROM INPUT STRING TO OUTPUT WOR LIB01610
         TR    3(1,R6),TABLEIN   TRANSLATE FROM EBCDIC TO ADE           LIB01620
         LA    R5,1(R5)          NEXT CHAR IN INPUT STRING              LIB01630
         LA    R6,4(R6)          NEXT WORD IN OUTPUT ARRAY              LIB01640
         BCT   R4,LAM2AS         LOOP UNTIL NCHAR CHARACTERS ARE PROCESSED LIB01650
*                                                                       LIB01660
         L     R13,SAVAR+4       RETURN                                 LIB01670
         LM    14,12,12(13)                                             LIB01680
         LA    R15,0                                                    LIB01690
         BR    14                                                       LIB01700
         EJECT                                                          LIB01710
*        END TOADE                                                      LIB01720
```

```
*                                                                       LIB01730
*************************************************************************LIB01740
* SUBROUTINE TOEBCD CONVERTS AN ADE CHARACTER RIGHT JUSTIFIED IN EACH  *LIB01750
* ELEMENT OF THE INPUT ARRAY TO AN EBCDIC CHARACTER AND PUTS           *LIB01760
* IT IN THE OUTPUT CHARACTER STRING.                                   *LIB01770
*                                                                      *LIB01780
*      FORTRAN CALLING SEQUENCE:  CALL TCEBCD(NCHAR,KADE,KAM)          *LIB01790
*                                                                      *LIB01800
*         WHERE:  NCHAR= NUMBER OF ELEMENTS IN INPUT ARRAY.            *LIB01810
*                 KADE=  INPUT ARRAY OF NCHAR ELEMENTS, EACH ELEMENT   *LIB01820
*                        CONTAINS AN ADE CHARACTER RIGHT JUSTIFIED.    *LIB01830
*                 KAM=   OUTPUT STRING OF NCHAR ADE CHARACTERS.        *LIB01840
*************************************************************************LIB01850
          ENTRY TOEBCD                                                  LIB01860
TOEBCD    B     12(0,15)                                                LIB01870
          DC    AL1(6)                                                  LIB01880
          DC    CL6'TOEBCD'                                             LIB01890
          SAVE (14,12)                                                  LIB01900
          LR    R12,R15                                                 LIB01910
          USING TOEBCD,R12                                              LIB01920
          ST    R13,SAVAR+4                                             LIB01930
          LA    R13,SAVAR                                               LIB01940
*                                                                       LIB01950
          L     R2,0(R1)          R2=ADDR OF PARM1                      LIB01960
          L     R4,0(R2)          R4=PARM1                              LIB01970
          L     R5,4(R1)          R5=ADDR OF PARM2                      LIB01980
          L     R6,8(R1)          R6=ADDR OF PARM3                      LIB01990
LAS2AM    MVC   0(1,R6),3(R5)     MOVE BYTE TO OUTPUT STRING            LIB02000
          LA    R5,4(R5)          NEXT WORD ON INPUT ARRAY              LIB02010
          LA    R6,1(R6)          NEXT BYTE IN OUTPUT STRING            LIB02020
          BCT   R4,LAS2AM         LOOP UNTIL NCHAR CHARACTERS ARE PROCESSED LIB02030
          L     R4,0(R2)          R4=PARM1                              LIB02040
          BCTR  R4,0              DECREASE R4 BY 1                      LIB02050
          STC   R4,TRANS2+1        LENGTH OF STRING                     LIB02060
          L     R6,8(R1)          R6=ADDR OF PARM3                      LIB02070
TRANS2    TR    0(1,R6),TABLECUT  TRANSLATE ASCII TO EBCDIC             LIB02080
*                                                                       LIB02090
          L     R13,SAVAR+4       RETURN                                LIB02100
          LM    14,12,12(13)                                            LIB02110
          LA    R15,0                                                   LIB02120
          BR    14                                                      LIB02130
          EJECT                                                         LIB02140
*         END TOEBCD                                                    LIB02150
*                                                                       LIB02160
```

```
*                THIS TABLE IS USED TC CONVERT ASCII TO EBCDIC          LIB02180
*                                                                      LIB02190
TABLEOUT EQU   *                                                       LIB02200
*                                                                      LIB02210
*                   0 1 2 3 4 5 6 7 8 9 A B C D E F                    LIB02220
*                                                                      LIB02230
         DC    X'00010203372D2E2F1605250B0C0D0E0F'  0                  LIB02240
         DC    X'101112133C3D3226181 93F271C1D1E1F'  1                 LIB02250
         DC    X'405A7F7B5B6C507D4D5D5C4E6B604B61'  2                  LIB02260
         DC    X'F0F1F2F3F4F5F6F7F8F97A5E4C7E6E6F'  3                  LIB02270
         DC    X'7CC1C2C3C4C5C6C7C8C9D1D2D3D4D5D6'  4                  LIB02280
         DC    X'D7D8D9E2E3E4E5E6E7E8E9ADE0BD5F6D'  5                  LIB02290
         DC    X'79818283848586878889919293949596'  6                  LIB02300
         DC    X'9798999A2A3A4A5A6A7A8A9C06AD0A107'  7                 LIB02310
*                                                                      LIB02330
*                THIS TABLE IS USED TO CONVERT EBCDIC TO ASCII         LIB02340
*                                                                      LIB02350
TABLEIN  EQU   *                                                       LIB02360
*                                                                      LIB02370
*                   0 1 2 3 4 5 6 7 8 9 A B C D E F                    LIB02380
*                                                                      LIB02400
         DC    X'00010203000S0C7F0000000B0C0D0E0F'  0                  LIB02410
         DC    X'101112133C000800181900001C1D1E1F'  1                  LIB02420
         DC    X'00000000000A171B0000000000050607'  2                  LIB02430
         DC    X'0000160000000000400000000141500 1A'  3                LIB02440
         DC    X'20000000000000000000000 2E3C282B00'  4                LIB02450
         DC    X'26000000000000000000021242A293B5E'  5                 LIB02460
         DC    X'2D2F0000000000000000007C2C255F3E3F'  6                LIB02470
         DC    X'00000000000000000006 03A2340273D22'  7                LIB02480
         DC    X'00616263646566676869007B00000000'  8                  LIB02490
         DC    X'006A6B6C6D6E6F707172007D00000000'  9                  LIB02500
         DC    X'007E737475767778797A0000005B0000'  A                  LIB02510
         DC    X'0000000000000000000000005D0000'  B                    LIB02520
         DC    X'7B41424344454647484900000000000'  C                   LIB02530
         DC    X'7D4A4B4C4D4E4F505152000000000000'  D                  LIB02540
         DC    X'5C00535455565758595A000000000000'  E                  LIB02550
         DC    X'3031323334353637383900000000000'  F                   LIB02560
*                                                                      LIB02570
         REGEQU                                                        LIB02580
LN       DS    1F                                                      LIB02610
SAVAR    DS    18F                                                     LIB02620
ZEROES   DC    X'00000000'                                             LIB02630
BUFF     DC    CL130' '                                                LIB02640
*                                                                      LIB02650
*        END ROUTINES FOR GRAPHICS PACKAGE OF LIBR5.                   LIB02660
*                                                                      LIB02670
```

```
*****************************************************************************  LIB02680
*                                                                               LIB02690
*         START ROUTINES FOR CHARACTER MANIPULATION PACKAGE OF LIBR5.            LIB02700
*                                                                               LIB02710
*****************************************************************************  LIB02720
*         PURPOSE.                                                            * LIB02730
*               THIS SUBROUTINE TRANSFERS A STRING OF N CHARACTERS            LIB02740
*               (4 PER WORD) INTO AN ARRAY (1 PER WORD LEFT JUSTIFIED       * LIB02750
*                WITH THE REST OF THE SPACE BLANKED)                        * LIB02760
*                                                                           * LIB02770
*         CALL.                                                             * LIB02780
*      CALL DECODE(N,BUFF,LIST)                                             * LIB02790
*                                                                           * LIB02800
*         ARGUMENTS                                                         * LIB02810
*               N                 NUMBER OF CHARACTERS                      * LIB02820
*               BUFF              ARRAY CONTAINING THE INITIAL STRING       * LIB02830
*                                 WITH 4 CHARACTERS PER WORD                * LIB02840
*               LIST              ARRAY CONTAINING THE STRING WITH 1        * LIB02850
*                                 CHARACTER PER WORD                        * LIB02860
*                                                                           * LIB02870
*****************************************************************************  LIB02880
DECODE    BEGIN                                                               LIB02890
          LM      2,4,0(1)          R2-R4 = ADR. OF ARGUMENTS                 LIB02900
          L       5,0(,2)           R5 = NB. OF CHARACTERS                    LIB02910
          SR      6,6                                                         LIB02920
          L       7,=CL4'    '                                                LIB02930
DECODE10  IC      6,0(,3)                                                     LIB02940
          SLL     7,8                                                         LIB02950
          SRDL    6,8                                                         LIB02960
          ST      7,0(,4)                                                     LIB02970
          LA      3,1(,3)                                                     LIB02980
          LA      4,4(,4)                                                     LIB02990
          BCT     5,DECODE10                                                  LIB03000
          RETURN (14,12),T                                                    LIB03010
          EJECT                                                               LIB03020
*         END DECODE                                                          LIB03030
```

```
*                                                                       LIB03040
*************************************************************************LIB03050
*       PURPOSE.                                                        *LIB03060
*             THIS FUNTION PACKS A STRING OF N CHARACTERS               *LIB03070
*             (1 PER WORD LEFT JUSTIFIED WITH THE REST BLANKED) IN      *LIB03080
*             A STRING OF CHARACTERS (4  PER WORD)                      *LIB03090
*                                                                       *LIB03100
*       CALL.                                                           *LIB03110
*    CALL ENCODE(N,BUFF,LIST)                                           *LIB03120
*                                                                       *LIB03130
*       ARGUMENTS                                                       *LIB03140
*             N              NUMBER OF CHARACTERS                       *LIB03150
*             BUFF           ARRAY CONTAINING THE PACKED STRING         *LIB03160
*                            (4 CHARACTERS PER WORD)                    *LIB03170
*             LIST           ARRAY CONTAINING THE ORIGINAL STRING       *LIB03180
*                            (1 CHARACTER PER WORD)                     *LIB03190
*                                                                       *LIB03200
*                                                                       *LIB03210
*************************************************************************LIB03220
ENCODE   BEGIN                                                          LIB03230
         LM       2,5,0(1)          R2-R4 = ADR. OF ARGUMENTS          LIB03240
         L        2,0(,2)                                              LIB03250
         LR       5,2                                                  LIB03260
         BCTR     5,0                                                  LIB03270
         SRL      5,2                                                  LIB03280
         SLL      5,2                                                  LIB03290
         L        0,=CL4'  '                                           LIB03300
         ST       0,0(5,3)          BLANK THE LAST WORD OF BUF         LIB03310
ENCODE10 IC       6,0(,4)                                              LIB03320
         STC      6,0(,3)                                              LIB03330
         LA       4,4(,4)                                              LIB03340
         LA       3,1(,3)                                              LIB03350
         BCT      2,ENCODE10                                           LIB03360
         RETURN   (14,12),T                                            LIB03370
         EJECT                                                        LIB03380
*        END ENCODE                                                     LIB03390
```

```
*                                                                       LIB03400
*************************************************************************LIB03410
*       PURPOSE.                                                        *LIB03420
*            THIS SUBROUTINE TRANSFERS A STRING OF N CHARACTERS         LIB03430
*            (4 PER WORD) INTO A STRING (1 PER WORD RIGHT               *LIB03440
*            JUSTIFIED WITH THE REST ZEROED)                            *LIB03450
*                                                                       *LIB03460
*       CALL.                                                           *LIB03470
*    CALL DECOD(N,BUFF,LIST)                                            *LIB03480
*                                                                       *LIB03490
*       ARGUMENTS                                                       *LIB03500
*            N              NUMBER OF CHARACTERS                       *LIB03510
*            BUFF           ARRAY CONTAINING THE INITIAL STRING        *LIB03520
*                           WITH 4 CHARACTERS PER WORD                 *LIB03530
*            LIST           ARRAY CONTAINING THE STRING WITH 1         *LIB03540
*                           CHARACTER PER WORD                         *LIB03550
*                                                                       *LIB03560
*************************************************************************LIB03570
DECOD    BEGIN                                                          LIB03580
         LM       2,4,0(1)                                              LIB03590
         L        5,0(2)                                                LIB03600
DECOD10  SR       6,6                                                   LIB03610
*DECOD10  L        6,=CL4'    '          WAS SR   6,6                   LIB03620
         IC       6,0(3)                                                LIB03630
         ST       6,0(4)                                                LIB03640
         LA       3,1(3)                                                LIB03650
         LA       4,4(4)                                                LIB03660
         BCT      5,DECOD10                                             LIB03670
         RETURN   (14,12),T                                             LIB03680
         EJECT                                                          LIB03690
**                                                                      LIB03700
*       LOCAL VARIABLES                                                 LIB03710
*                                                                       LIB03720
SAVEAREA DS       18F                                                   LIB03730
ALIBR5A  DC       A(LIBR5A)                                             LIB03740
*                                                                       LIB03750
*        END DECOD                                                      LIB03760
```

```
*                                                                       LIB03770
*********************************************************************** LIB03780
*       PURPOSE.                                                      * LIB03790
*            THIS SUBROUTINE TRANSFORMS AN INTEGER INTO A STRING OF  * LIB03800
*            ALPHANUMERIC CHARACTERS                                 * LIB03810
*            THE STRING IS RIGHT JUSTIFIED - THE REST OF THE STRING  * LIB03820
*            IS FILLED WITH A CHARACTER FURNISHED BY                 * LIB03830
*            THE USER                                                * LIB03840
*                                                                    * LIB03850
*       LANGUAGE.                                                    * LIB03860
*            ASSEMBLY IBM OS-MVS                                     * LIB03870
*                                                                    * LIB03880
*       CALL.                                                        * LIB03890
*     CALL BTD(INT,LIST,LONG,NCAR,MASK)                              * LIB03900
*                                                                    * LIB03910
*       ARGUMENTS                                                    * LIB03920
*            INT          INTEGER TO BE TRANSLATED                 * LIB03930
*            LIST         ARRAY OF TRANSLATED  CHARACTERS          * LIB03940
*            LONG         NUMBER OF CHARACTERS TO TRANSLATE        * LIB03950
*                         (INCLUDING THE CHARACTERS TO BE MASKED)  * LIB03960
*            NCAR         NUMBER OF CHARACTERS GENERATED FOR THE   * LIB03970
*                         TRANSLATION OF THE NUMBER                * LIB03980
*            MASK         CHARACTERS USED TO MASK THE CHARACTERS   * LIB03990
*                         ON THE LEFT OF THOSE COMING FROM THE     * LIB04000
*                         TRANSLATION                              * LIB04010
*                                                                    * LIB04020
*       INPUT ARGUMENTS          INT,LONG,MASK                     * LIB04030
*       OUTPUT ARGUMENTS         LIST,NCAR                         * LIB04040
*                                                                    * LIB04050
*       AUTHOR.                                                      * LIB04060
*            A. REGNARD                                              * LIB04070
*********************************************************************** LIB04080
         ENTRY  BTD                                                    LIB04090
BTD      BC     15,8(15)                                              LIB04100
         DC     X'3'                                                  LIB04110
         DC     CL3'BTD'                                              LIB04120
         STM    14,12,12(13)                                          LIB04130
         BALR   2,0                                                   LIB04140
         USING  *,2                                                   LIB04150
*                                                                     LIB04160
         L      3,0(1)                                                LIB04170
         L      4,0(3)                                                LIB04180
         CVD    4,DBL                                                 LIB04190
         UNPK   RES(12),DBL+1(7)                                      LIB04200
         L      5,DOUZE                                               LIB04210
         L      4,RES                                                 LIB04220
         CL     4,ZERO                                                LIB04230
         BE     CBYTE                                                 LIB04240
```

```
                ST      4,TEST                                          LIB04250
B               TM      TEST,X'0F'                                      LIB04260
                BM      S                                               LIB04270
                S       5,UN                                            LIB04280
                TM      TEST+1,X'0F'                                    LIB04290
                BM      S                                               LIB04300
                S       5,UN                                            LIB04310
                TM      TEST+2,X'0F'                                    LIB04320
                BM      S                                               LIB04330
                S       5,UN                                            LIB04340
                B       S                                               LIB04350
*                                                                       LIB04360
DBYTE           L       4,RES+4                                         LIB04370
                S       5,QUATRE                                        LIB04380
                CL      4,ZERO                                          LIB04390
                BE      TBYTE                                           LIB04400
                ST      4,TEST                                          LIB04410
                B       B                                               LIB04420
*                                                                       LIB04430
TBYTE           L       4,RES+8                                         LIB04440
                S       5,QUATRE                                        LIB04450
                CL      4,ZERO                                          LIB04460
                BE      VALNUL                                          LIB04470
                ST      4,TEST                                          LIB04480
                B       B                                               LIB04490
*                                                                       LIB04500
VALNUL          SR      5,5                                             LIB04510
                B       POSITIF                                         LIB04520
*                                                                       LIB04530
S               TM      RES+11,X'10'                                    LIB04540
                BZ      POSITIF                                         LIB04550
                LA      6,RES                                           LIB04560
                A       6,ONZE                                          LIB04570
                SR      6,5                                             LIB04580
                MVC     0(1,6),MOINS                                    LIB04590
                A       5,UN                                            LIB04600
*                                                                       LIB04610
POSITIF         MVZ     RES+11(1),CF                                    LIB04620
*                                                                       LIB04630
                L       9,16(1)                                         LIB04640
                LA      7,RES                                           LIB04650
                LR      8,5                                             LIB04660
BOUC            MVC     0(1,7),0(9)                                     LIB04670
                A       7,UN                                            LIB04680
                A       8,UN                                            LIB04690
                C       8,DOUZE                                         LIB04700
                BNE     BOUC                                            LIB04710
*                                                                       LIB04720
```

```
                LM      7,9,4(1)                                LIB04730
                ST      5,0(9)                                  LIB04740
                L       10,0(8)                                 LIB04750
                AR      7,10                                    LIB04760
                S       7,UN                                    LIB04770
                LA      11,RES+11                               LIB04780
                L       12,UN                                   LIB04790
*                                                               LIB04800
BOUCLE          MVC     0(1,7),0(11)                            LIB04810
                SR      10,12                                   LIB04820
                SR      7,12                                    LIB04830
                SR      11,12                                   LIB04840
                C       10,NUL                                  LIB04850
                BNE     BOUCLE                                  LIB04860
*                                                               LIB04870
                LM      2,12,28(13)                             LIB04880
                MVI     12(13),X'FF'                            LIB04890
                BCR     15,14                                   LIB04900
*                                                               LIB04910
DBL             DS      D                                       LIB04920
RES             DS      CL12                                    LIB04930
ZERO            DC      X'F0F0F0F0'                             LIB04940
UN              DC      X'00000001'                             LIB04950
QUATRE          DC      X'00000004'                             LIB04960
ONZE            DC      X'0000000B'                             LIB04970
DOUZE           DC      X'0000000C'                             LIB04980
TEST            DS      CL4                                     LIB04990
NUL             DC      X'00000000'                             LIB05000
MOINS           DC      X'60'                                   LIB05010
CF              DC      X'F0'                                   LIB05020
                EJECT                                           LIB05030
*               END BTD                                         LIB05040
```

```
*                                                                       LIB05050
*************************************************************************LIB05060
*            THIS SUBROUTINE PLACES A FLOATING POINT VARIABLE 'V'      *LIB05070
*       IN AN ARRAY 'T' (3A4) WITH FORMAT 1PE10.3                      *LIB05080
*                                                                      *LIB05090
*            FORTRAN CALL :   CALL ENF(V,T)                            *LIB05100
*                 V (R*4) ......:   FLOATING POINT VARIABLE            *LIB05110
*                 T (3A4) ......:   ARRAY TO BE TRANSLATED             LIB05120
*************************************************************************LIB05130
         ENTRY ENF                                                      LIB05140
ENF      BC    15,3+1+4(15)                                            LIB05150
         DC    X'3'                                                    LIB05160
         DC    CL3'ENF'                                                LIB05170
         STM   14,12,12(13)                                            LIB05180
         BALR  12,0                                                    LIB05190
         USING *,12                                                    LIB05200
         LM    2,3,0(1)                                                LIB05210
         MVC   10(2,3),BLANC          ZONE 10 CHARACT + 2 BLANKS       LIB05220
         L     1,=V(FCVEOUTP)                                          LIB05230
         BALR  0,1                                                     LIB05240
         DC    X'04'                  LENGTH OF THIS ZONE              LIB05250
         DC    X'0A'                  LENGHT OF THE RESULT             LIB05260
         DC    X'03'                  NB OF DECIMALS                   LIB05270
         DC    X'01'                  SCALE FACTOR                     LIB05280
*        *                                                              LIB05290
FIN      LM    2,12,28(13)                                             LIB05300
         MVI   12(13),X'FF'                                            LIB05310
         BCR   15,14                                                   LIB05320
BLANC    DC    CL2'  '                                                 LIB05330
         DC    V(IHOFCVTH)                                             LIB05340
         EJECT                                                         LIB05350
*        END ENF                                                       LIB05360
*                                                                      LIB05370
*        END ROUTINES FOR CHARACTER MANIPULATION PACKAGE OF LIBR5.     LIB05380
```

```
*                                                                      LIB05390
************************************************************************LIB05400
*                                                                      LIB05410
*        START ROUTINES FOR DATA MANAGEMENT PACKAGE OF LIBR5.          LIB05420
*                                                                      LIB05430
************************************************************************LIB05440
*  SUBROUTINE FRTCMX                                                   *LIB05450
*                                                                      *LIB05460
*  PURPOSE                                                             *LIB05470
*       TO ALLOW A USER TO INVOKE ALMOST ANY CP OR CMS COMMAND FROM    *LIB05480
*       WITHIN A FORTRAN PROGRAM.  NORMALLY AFTER THE INVOKED COM-     *LIB05490
*       MAND IS EXECUTED, CONTROL RETURNS TO THE FORTRAN PROGRAM.      *LIB05500
*                                                                      *LIB05510
*  USAGE                                                               *LIB05520
*       CALL FRTCMX (CMSRC,TOKEN1,TOKEN2,...,TOKENL)                   *LIB05530
*                                                                      *LIB05540
*  DESCRIPTION OF PARAMETERS                                           *LIB05550
*                                                                      *LIB05560
*       CMSRC IS THE CMS COMMAND RETURN CODE.  IT CAN BE USED IN THE   *LIB05570
*       FORTRAN CODE TO CHECK FOR ERRORS IN THE CMS COMMAND EXECUTION. *LIB05580
*                                                                      *LIB05590
*       EACH TOKEN IS A REAL*8 WORD CONTAINING LITERAL (HOLLERITH)     *LIB05600
*       INFORMATION WHICH IS AN ELEMENT OF A CP OR CMS COMMAND WHICH   *LIB05610
*       COULD OTHERWISE BE ISSUED BY THE USER AT A TERMINAL OR WITHIN  *LIB05620
*       AN EXEC FILE.                                                  *LIB05630
*                                                                      *LIB05640
*       EACH TOKEN MUST BE PADDED WITH BLANKS SO THAT IT HAS EXACTLY   *LIB05650
*       EIGHT CHARACTERS. THE INFORMATION IN THE TOKEN MUST BE LEFT-   *LIB05660
*       JUSTIFIED.                                                     *LIB05670
*                                                                      *LIB05680
*       SEE EXAMPLES BELOW.                                            *LIB05690
*                                                                      *LIB05700
*  REMARKS                                                             *LIB05710
*       1.  CMSRC IS A 5 DIGIT INTEGER.                                *LIB05720
*                                                                      *LIB05730
*       2. A MAXIMUM OF 20 TOKENS IS ALLOWED.  IF MORE ARE ATTEMPTED   *LIB05740
*          THE EFFECTIVE COMMAND IS TRUNCATED AFTER THE 20TH.          *LIB05750
*                                                                      *LIB05760
*       3. SUBJECT TO THE MAXIMUM, ANY NUMBER OF TOKENS IS ALLOWED.    *LIB05770
*                                                                      *LIB05780
*       4. IN GENERAL A COMMAND THAT RELOADS VIRTUAL CORE WILL NOT     *LIB05790
*          BE ALLOWED. EXAMPLES: FORTHX, SCRIPT, XEDIT, ANY LANGUAGE   *LIB05800
*          PROCESSOR, SORT, AND OTHER LARGE SYSTEM MODULES, SUCH AS    *LIB05810
*          COPYFILE AND MOVEFILE. IT MAY BE POSSIBLE TO LOAD AND       *LIB05820
*          EXECUTE A SMALL PROGRAM BY USING THE INCLUDE COMMAND.       *LIB05830
*                                                                      *LIB05840
*       5. THE FIRST TOKEN OF THE CP COMMAND MUST BE 'CP      ';       *LIB05850
*          WHEN AN EXEC FILE IS INVOKED, THE FIRST TOKEN MUST BE       *LIB05860
```

```
*           'EXEC    '.                                                    * LIB05870
*                                                                          * LIB05880
*       5. AS OF NOV '81 YOU MUST NOT ABBREVIATE 'PRINTER' WHEN            * LIB05890
*          USING FRTCMX TO ISSUE FILE DEFINITIONS.                         * LIB05900
*                                                                          * LIB05910
*   EXAMPLES                                                               * LIB05920
*       1. TO CLEAR THE SCREEN OF A 3278 TERMINAL:                         * LIB05930
*          CALL FRTCMX (IERR,'CLRSCRN ')                                   * LIB05940
*             NOTE: CLRSCRN IS A BUILT-IN IPF MODULE.                      * LIB05950
*                                                                          * LIB05960
*       2. TO INVOKE AN EXEC FILE NAMED 'MYEXEC' WITH ARGUMENTS 'ARG1'    * LIB05970
*          AND 'ARG2'.                                                     * LIB05980
*          CALL FRTCMX(IERR,'EXEC    ','MYEXEC  ','ARG1    ','ARG2    '* LIB05990
*                                                                          * LIB06000
*       3. TO ISSUE A CP SPOOL COMMAND TO CHANGE SECOND LABEL ON           * LIB06010
*          PRINTED OUTPUT:                                                 * LIB06020
*          CALL FRTCMX(IERR,'CP      ','SPOOL   ','PRINTER ','DIST    '* LIB06030
*         1   'NEWLABEL')                                                  * LIB06040
*                                                                          * LIB06050
*       4. TO ISSUE A FILEDEF TO SEND OUTPUT ON UNIT 6 TO PRINTER:         * LIB06060
*                                                                          * LIB06070
*          REAL*8 COM(8)/'FILEDEF ','6       ','PRINTER ','(       ',   * LIB06080
*         1   'RECFM   ','FA      ','BLOCK   ','133     ')               * LIB06090
*          CALL FRTCMX(COM(1),COM(2),COM(3),COM(4),COM(5),COM(6),          * LIB06100
*         1    COM(7),COM(8))                                             * LIB06110
*                                                                          * LIB06120
*            NOTE:  THE LEFT PARENTHESIS WHICH DELIMITS OPTIONS MUST       * LIB06130
*            APPEAR AS A SEPARATE TOKEN. THE RIGHT PARENTHESIS MAY         * LIB06140
*            BE OMITTED.                                                   * LIB06150
*                                                                          * LIB06160
*   IDENTIFICATION                                                         * LIB06170
*        PROGRAMMER: ROGER HILLEARY    DATE: APRIL 1981                    * LIB06180
*        WRITEUP REVISED NOV '81                                           * LIB06190
*        MODIFIED TO RETURN CMS RETURN CODE BY: HANS DOELMAN, JAN 82.      * LIB06200
*                                                                          * LIB06210
*************************************************************************** LIB06220
*                                                                           LIB06230
*                                                                           LIB06240
FRTCMX   ENTRY FRTCMX                                                      LIB06250
         BC    15,8+4(15)    STANDARD FORTRAN LINKAGE                      LIB06260
         DC    X'7'                                                        LIB06270
         DC    CL7'FRTCMX '                                                LIB06280
         STM   14,12,12(13)                                                LIB06290
*                                                                          LIB06300
         BALR  2,0                                                        LIB06310
         USING *,2                                                        LIB06320
************************                                                   LIB06330
         L     6,0(1)                                                      LIB06340
         ST    6,RCADR                                                     LIB06350
```

```
          LA   1,4(1,0)
***************************
*
          LA   4,8              8 IN REG 4
          LA   5,152            8*19 IN REG 5
*
          LA   3,0              ZERO IN REG 3 TO START
*
L1        L    6,0(1)           ADDRESS OF EACH TOKEN TO REG 6
          LTR  6,6              TEST FOR LAST TOKEN (MINUS)
          LD   0,0(6)           GET EACH TOKEN INTO FP REG 0
          LA   1,4(1,0)         INCREMENT REG 1 BY 4
          STD  0,TOKENS(3)      STORE EACH TOKEN INTO TABLE BELOW
          BC   4,L3             BRANCH IF THIS WAS LAST TOKEN
          BXLE 3,4,L1           MAX OF 20 TOKENS ALLOWED
          BC   15,L4            UNCONDITIONAL BRANCH
L3        LA   3,8(3,0)         INCREMENT REG 3 BY 4
L4        LD   0,DELIM
          STD  0,TOKENS(3)      STORE DELIMITER
*
          LA   1,TOKENS
          SVC  202              GIVE CONTROL TO CMS
          DC   AL4(*+4)
***************************
          L    2,RCADR
          ST   15,0(2)
***************************
*
          LM   2,12,28(13)      STANDARD RETURN LINKAGE
          MVI  12(13),X'FF'
          BCR  15,14
***************************
RCADR     DS   1F
***************************
*
TOKENS    DS   0D
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
          DC   CL8'          '
```

```
LIB06350
LIB06360
LIB06370
LIB06380
LIB06390
LIB06400
LIB06410
LIB06420
LIB06430
LIB06440
LIB06450
LIB06460
LIB06470
LIB06480
LIB06490
LIB06500
LIB06510
LIB06520
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LIB06680
LIB06690
LIB06700
LIB06710
LIB06720
LIB06730
LIB06740
LIB06750
LIB06760
LIB06770
LIB06780
LIB06790
LIB06800
LIB06810
LIB06820
```

```
                DC      CL8'        '                                   LIB06830
                DC      CL8'        '                                   LIB06840
                DC      CL8'        '                                   LIB06850
                DC      CL8'        '                                   LIB06860
                DC      CL8'        '                                   LIB06870
                DC      CL8'        '                                   LIB06880
                DC      CL8'        '                                   LIB06890
                DC      CL8'        '                                   LIB06900
DELIM           DC      8X'FF'                                          LIB06910
                EJECT                                                   LIB06920
*               ENC FRTCMX                                              LIB06930
```

```
*                                                                       LIB06940
************************************************************************LIB06950
*                                                                      *LIB06960
*     ROUTINE TO CONVERT AN INTEGER*4 TO A REAL*8 (LEFT JUSTIFIED)     *LIB06970
*                                                                      *LIB06980
*                    CALL CONVRT (III,RRR)                             *LIB06990
*                                                                      *LIB07000
*                    III INTEGER*4 INPUT                               *LIB07010
*                    RRR REAL*8 OUTPUT                                 *LIB07020
*                                                                      *LIB07030
************************************************************************LIB07040
          ENTRY CONVRT                                                  LIB07050
CONVRT    B     12(15)                                                  LIB07060
          DC    AL1(6)                                                  LIB07070
          DC    CL6'CONVRT'                                             LIB07080
          DS    0F                                                      LIB07090
          STM   14,12,12(13)  SAVE INCOMING REGISTERS                   LIB07100
          LR    12,15         SET USING REG. ON 12                      LIB07110
          USING CONVRT,12     SET USING REG. ON 12                      LIB07120
          ST    13,SAVA+4     SAVE INCOMING REG.13                      LIB07130
          LA    13,SAVA       NOW USE OUR OWN                           LIB07140
          L     2,0(1)         FIRST ARG. ADDR TO REG. 2                LIB07150
          L     9,0(2)         VALUE OF FIRST ARG. TO REG. 9            LIB07160
          CVD   9,BUF          CONVERT FIRST ARG. TO PACK DECIMAL       LIB07170
          UNPK  BUF+8(8),BUF+3(5)      AND THEN TO EBCDIC               LIB07180
          OI    BUF+15,X'F0'   CORRECT THE SIGN--WE DON'T NEED TO       LIB07190
          L     2,4(1)         SECOND ARG. ADDR TO REG. 2               LIB07200
          MVI   0(2),X'40'     INITIALIZE VARIABLE TO BLANKS            LIB07210
          MVC   1(7,2),0(2)                                             LIB07220
          MVC   0(2,2),BUF+14 MOVE CONVERTED NUMBER (ONLY 2 CHAR)       LIB07230
          L     13,SAVA+4     RESTORE REG. 13 TO CALLER'S               LIB07240
          LM    14,12,12(13)   RESTORE ALL REG.                         LIB07250
          BR    14             RETURN                                   LIB07260
BUF       DS    2D                                                      LIB07270
SAVA      DS    18F                                                     LIB07280
          EJECT                                                         LIB07290
*         END CONVRT                                                    LIB07300
*                                                                       LIB07310
          END                                                           LIB07320
```

FILE TAPE2MVS JCL

```
//HUNDLEY1 JOB (3161,0020),'R. HUNDLEY SMC 2436',CLASS=D
//XX PROC
//  EXEC PGM=IEBGENER
//SYSPRINT DD DUMMY
//SYSIN DD DUMMY
//SYSUT1 DD UNIT=3400-4,VOL=SER=GIFTS2,
//      DISP=(OLD,PASS),LABEL=(&FN,BLP,,IN),
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600,DEN=2,OPTCD=Q)
//SYSUT2 DD UNIT=3350,VOL=SER=MVS004,
//      DISP=(NEW,KEEP),SPACE=(CYL,(1,1)),
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400),
//      DSN=S3161.&FNAME
//  PEND
//  EXEC XX,FN=1,FNAME=FILE1
//  EXEC XX,FN=2,FNAME=FILE2
//  EXEC XX,FN=3,FNAME=FILE3
//  EXEC XX,FN=4,FNAME=FILE4
//  EXEC XX,FN=5,FNAME=FILE5
//  EXEC XX,FN=6,FNAME=FILE6
//  EXEC XX,FN=7,FNAME=FILE7
//  EXEC XX,FN=8,FNAME=FILE8
//  EXEC XX,FN=9,FNAME=FILE9
//  EXEC XX,FN=10,FNAME=FILE10
//  EXEC XX,FN=11,FNAME=FILE11
//  EXEC XX,FN=12,FNAME=FILE12
//  EXEC XX,FN=13,FNAME=FILE13
//  EXEC XX,FN=14,FNAME=FILE14
//  EXEC XX,FN=15,FNAME=FILE15
//  EXEC XX,FN=16,FNAME=FILE16
//  EXEC XX,FN=17,FNAME=FILE17
//  EXEC XX,FN=18,FNAME=FILE18
//  EXEC XX,FN=19,FNAME=FILE19
//  EXEC XX,FN=20,FNAME=FILE20
//  EXEC XX,FN=21,FNAME=FILE21
//  EXEC XX,FN=22,FNAME=FILE22
//  EXEC XX,FN=23,FNAME=FILE23
//  EXEC XX,FN=24,FNAME=FILE24
//  EXEC XX,FN=25,FNAME=FILE25
//  EXEC XX,FN=26,FNAME=FILE26
//  EXEC XX,FN=27,FNAME=FILE27
//  EXEC XX,FN=28,FNAME=FILE28
//  EXEC XX,FN=29,FNAME=FILE29
//  EXEC XX,FN=30,FNAME=FILE30
//  EXEC XX,FN=31,FNAME=FILE31
//  EXEC XX,FN=32,FNAME=FILE32
//  EXEC XX,FN=33,FNAME=FILE33
//  EXEC XX,FN=34,FNAME=FILE34
//  EXEC XX,FN=35,FNAME=FILE35
//  EXEC XX,FN=36,FNAME=FILE36
//  EXEC XX,FN=37,FNAME=FILE37
```

FILE MVS2CMS EXEC

```
*****************************************************************
*                                                               *
*    MVS2CMS EXEC                                               *
*                                                               *
*    THIS EXEC WILL CAUSE THE TRANSFER OF THE GIFTS SOURCE      *
*    CODE FROM MVS DISK MVS004 TO THE USER'S CMS DISK SPACE.    *
*                                                               *
*    PRIOR TO USE OF THIS EXEC, LINK TO MVS004 BY ISSUING:      *
*                                                               *
*            CP LINK MVS 36B 36B RR                             *
*            ACC 36B E                                          *
*                                                               *
*                                                               *
*****************************************************************
FILEDEF INMOVE E DSN S3161 FILE1
FILEDEF OUTMOVE DISK GIFTS5 INF
MOVEFILE INMOVE OUTMOVE
FILEDEF  INMOVE E DSN S3161 FILE2
FILEDEF  OUTMOVE DISK AUTOL FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY AUTOL FORTRAN A = PACKED = (PA
ERASE AUTOL FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE3
FILEDEF  OUTMOVE DISK BULKF FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY BULKF FORTRAN A = PACKED = (PA
ERASE BULKF FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE4
FILEDEF  OUTMOVE DISK BULKLB FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY BULKLB FORTRAN A = PACKED = (PA
ERASE BULKLB FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE5
FILEDEF  OUTMOVE DISK BULKM FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY BULKM FORTRAN A = PACKED = (PA
ERASE BULKM FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE6
FILEDEF  OUTMOVE DISK BULKS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY BULKS FORTRAN A = PACKED = (PA
ERASE BULKS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE7
FILEDEF  OUTMOVE DISK DECOM FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY DECOM FORTRAN A = PACKED = (PA
ERASE DECOM FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE8
FILEDEF  OUTMOVE DISK DEFCS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY DEFCS FORTRAN A = PACKED = (PA
ERASE DEFCS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE9
FILEDEF  OUTMOVE DISK DEFL FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY DEFL FORTRAN A = PACKED = (PA
ERASE DEFL FORTRAN A
```

```
FILEDEF  INMOVE E DSN S3161 FILE10
FILEDEF  OUTMOVE DISK EDITLB FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY EDITLB FORTRAN A = PACKED = (PA
ERASE EDITLB FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE11
FILEDEF  OUTMOVE DISK EDITM FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY EDITM FORTRAN A = PACKED = (PA
ERASE EDITM FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE12
FILEDEF  OUTMOVE DISK EDITS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY EDITS FORTRAN A = PACKED = (PA
ERASE EDITS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE13
FILEDEF  OUTMOVE DISK ESTIM FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY ESTIM  FORTRAN A = PACKED = (PA
ERASE ESTIM FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE14
FILEDEF  OUTMOVE DISK LOADS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY LOADS FORTRAN A = PACKED = (PA
ERASE LOADS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE15
FILEDEF  OUTMOVE DISK LOCAL FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY LOCAL FORTRAN A = PACKED = (PA
ERASE LOCAL FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE16
FILEDEF  OUTMOVE DISK OPTIM FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY OPTIM FORTRAN A = PACKED = (PA
ERASE OPTIM FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE17
FILEDEF  OUTMOVE DISK PRINT FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY PRINT FORTRAN A = PACKED = (PA
ERASE PRINT FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE18
FILEDEF  OUTMOVE DISK REDCS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY REDCS FORTRAN A = PACKED = (PA
ERASE REDCS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE19
FILEDEF  OUTMOVE DISK RESIDU FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY RESIDU FORTRAN A = PACKED = (PA
ERASE RESIDU FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE20
FILEDEF  OUTMOVE DISK RESULT FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY RESULT FORTRAN A = PACKED = (PA
ERASE RESULT FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE21
FILEDEF  OUTMOVE DISK SAVEK FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY SAVEK FORTRAN A = PACKED = (PA
ERASE SAVEK FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE22
FILEDEF  OUTMOVE DISK STIFF FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY STIFF FORTRAN A = PACKED = (PA
ERASE STIFF FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE23
FILEDEF  OUTMOVE DISK STRESS FORTRAN
```

```
MOVEFILE INMOVE OUTMOVE
COPY STRESS FORTRAN A = PACKED = (PA
ERASE STRESS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE24
FILEDEF  OUTMOVE DISK SUBS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY SUBS FORTRAN A = PACKED = (PA
ERASE SUBS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE25
FILEDEF  OUTMOVE DISK TRAN1 FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TRAN1 FORTRAN A = PACKED = (PA
ERASE TRAN1 FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE26
FILEDEF  OUTMOVE DISK TRAN2 FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TRAN2 FORTRAN A = PACKED = (PA
ERASE TRAN2 FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE27
FILEDEF  OUTMOVE DISK TRANS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TRANS FORTRAN A = PACKED = (PA
ERASE TRANS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE28
FILEDEF  OUTMOVE DISK TESTCS FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TESTCS FORTRAN A = PACKED = (PA
ERASE TESTCS FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE29
FILEDEF  OUTMOVE DISK TESTIO FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TESTIO FORTRAN A = PACKED = (PA
ERASE TESTIO FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE30
FILEDEF  OUTMOVE DISK TEST FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TEST FORTRAN A = PACKED = (PA
ERASE TEST FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE31
FILEDEF  OUTMOVE DISK TEST2 FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TEST2 FORTRAN A = PACKED = (PA
ERASE TEST2 FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE32
FILEDEF  OUTMOVE DISK TSTPLT FORTRAN
MOVEFILE INMOVE OUTMOVE
COPY TSTPLT FORTRAN A = PACKED = (PA
ERASE TSTPLT FORTRAN A
FILEDEF  INMOVE E DSN S3161 FILE33
FILEDEF  OUTMOVE DISK LIBR. FORTRAN
MOVEFILE INMOVE OUTMOVE
FILEDEF  INMOVE E DSN S3161 FILE34
FILEDEF  OUTMOVE DISK LIBR2 FORTRAN
MOVEFILE INMOVE OUTMOVE
FILEDEF  INMOVE E DSN S3161 FILE35
FILEDEF  OUTMOVE DISK LIBR3 FORTRAN
MOVEFILE INMOVE OUTMOVE
FILEDEF  INMOVE E DSN S3161 FILE36
FILEDEF  OUTMOVE DISK LIBR4 FORTRAN
MOVEFILE INMOVE OUTMOVE
FILEDEF  INMOVE E DSN S3161 FILE37
FILEDEF  OUTMOVE DISK LIBR5 FORTRAN
MOVEFILE INMOVE OUTMOVE
REL E (DET
FLIST
```

APPENDIX J:

GIFTS USER INSTRUCTIONS FOR THE IBM (CP/CMS) VERSION

TERMINAL USAGE

GIFTS may be executed on any terminal, but if the terminal is not a Tektronix 4000 series graphics terminal, plot commands must not be used as they will be meaningless and may cause termination of execution. If using a non-graphics terminal, the user will have only the alphanumeric output from GIFTS available.

GIFTS ANALYSIS PROCEDURES

The analysis procedures described in GIFTS User's Reference Manual are used, but the module IBMUDB must first be executed to create the data base for the analysis. Following the execution of IBMUDB, the user will have 48 (small) files on the 'A' disk. Upon the completion of an analysis, it is the responsibility of the user to erase these files, as needed, from his disk space.

STORAGE REQUIREMENTS

To ensure sufficient core for an analysis, prior to executing a module, issue the command:

```
CP DEFINE STORAGE 1M
```

which will place you in the CP operating environment. To return to the CMS environment, issue the command:

CP IPL CMS.

LINKING TO THE GIFTS SYSTEM'S DISK SPACE

In order to perform a GIFTS analysis, the GIFTS system's disk space must be linked to and accessed as the user's 'C' disk. This can be accomplished by issuing the command (user input in lower case, computer output in upper case):

```
cp link 316lp 191 199 rr
ENTER READ PASSWORD:
gifts
R; T=0.01/0.01 20:25:17
access 199 c
C (199) R/O
R; T=0.01/0.02 20:25:25
```

Once linked and accessed as the user's 'C' disk, the GIFTS system is ready for use.

ENTERING A BLANK LINE IN GIFTS

At times, during execution of the GIFTS modules, it will be necessary to issue a blank line, or GIFTS may even prompt the user to enter a carriage return. It is of the utmost importance in both cases, that a space, plus a carriage return be entered. If a carriage return alone is entered, program module execution will be terminated.

EXECUTING A GIFTS PROGRAM MODULE

To execute a GIFTS program module, issue the command:

RUN XXXXXX

where XXXXXX is the name of the desired module. This will cause the desired module and necessary libraries to be loaded and executed. The user is reminded that module IBMUDB must be executed at the start of each analysis.

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